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TECHNOLOGY
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Construction Methods and Equipment

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January, 1938

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ROAD BUILDERS' NUMBER

Lincoln Tunnel Roadway under Hudson River, N. Y. City, paved with de-aired brick

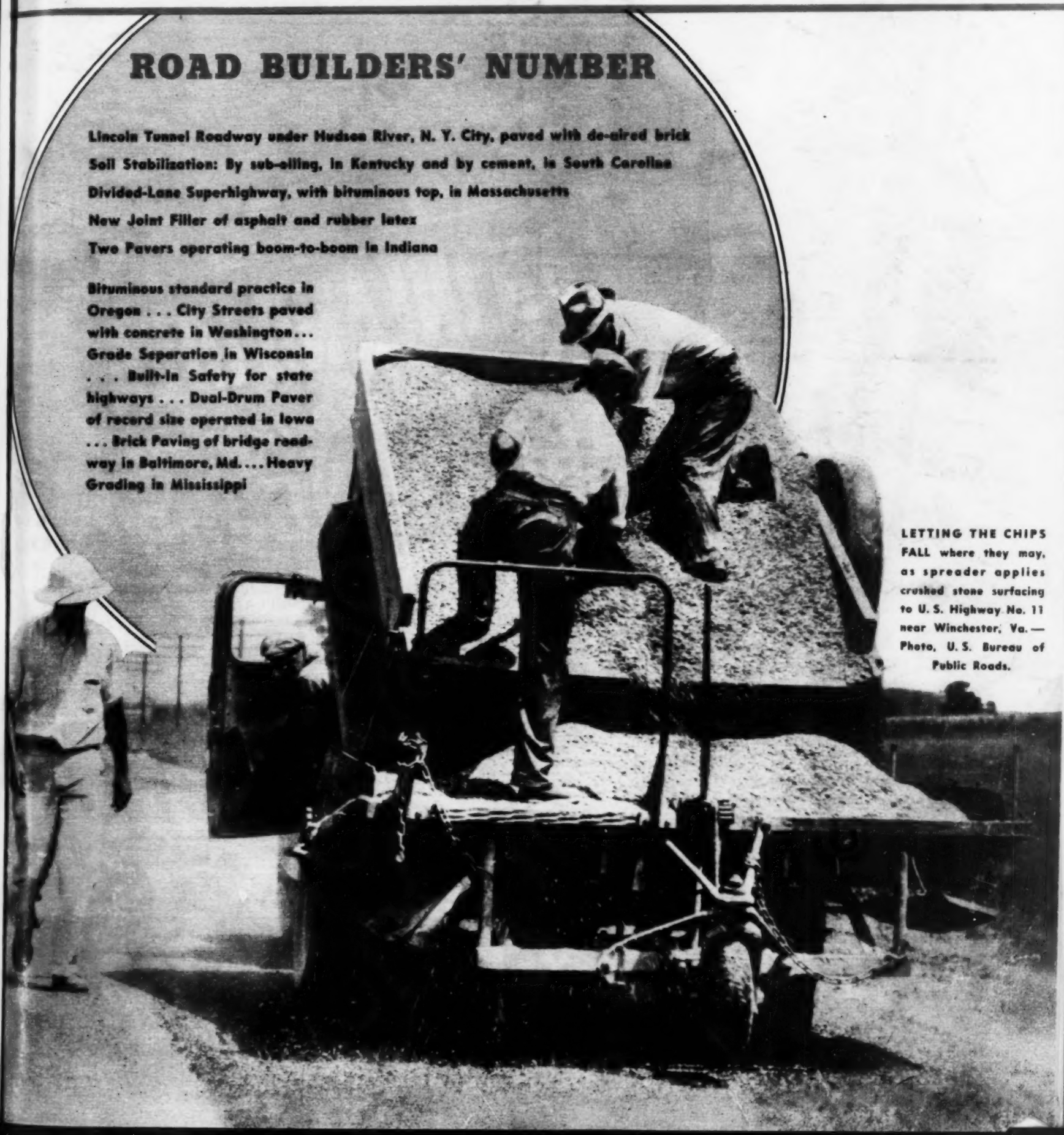
Soil Stabilization: By sub-oiling, in Kentucky and by cement, in South Carolina

Divided-Lane Superhighway, with bituminous top, in Massachusetts

New Joint Filler of asphalt and rubber latex

Two Pavers operating boom-to-boom in Indiana

Bituminous standard practice in Oregon . . . City Streets paved with concrete in Washington . . . Grade Separation in Wisconsin . . . Built-in Safety for state highways . . . Dual-Drum Paver of record size operated in Iowa . . . Brick Paving of bridge roadway in Baltimore, Md. . . . Heavy Grading in Mississippi



LETTING THE CHIPS FALL where they may, as spreader applies crushed stone surfacing to U. S. Highway No. 11 near Winchester, Va.—Photo, U. S. Bureau of Public Roads.

R v.20 1938

Working closely with contractors throughout the country, Inland engineers have established a well-earned reputation for design and construction ideas that save time and money.

A recent example was the Mississippi River Improvement Lock No. 14 at LeClaire, Iowa, built by the Central Engineering Co., for the U. S. Army Engineers.

There was opportunity to save several thousand dollars on this piling job. Inland engineers began working with the contractors early in the planning stages with this idea in mind.

The result was an out-of-the-ordinary type of installation, completed with full advantage of the anticipated economy and no sacrifice of practical results secured.

It will pay you to make use of this Inland experience on your next piling or other construction job. Inland engineers will justify the confidence you place in them.

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Many Uses for Inland 4-Way Traffic Plate

Its 4-Way safety, 4-Way stiffness, 4-Way cleaning and quick drainage and 4-Way Matching, suggest many varied uses for Inland 4-Way Traffic Plate. Resurfacing bridge floors, building stairs, walkways, platforms and covering openings in floors and sidewalks, are a few of them. A folder containing complete information will be sent on request.

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Tech

CURRENT JOBS

. . . . and Who's Doing Them

ROAD BUILDERS' NUMBER

This issue, appearing on the eve of the annual convention and Road Show of the American Road Builders' Association is devoted exclusively to highways. Succeeding issues, of course, will deal with subjects of general construction interest.—Editor.

DAMS

Outstanding news event in the field of construction last month was the receipt of bids Dec. 10 by the U. S. Bureau of Reclamation for the construction of the top portion of Grand Coulee dam on the Columbia River in Washington. Project for carrying dam to full height of 553 ft. will involve placement of 6,000,000 cu.yd. of concrete, nearly twice as much as was placed in Boulder dam. The low bid, amounting to $34,442,240, was submitted by the **Interior Construction Co.**, comprising the following contracting firms: **Silas Mason Co.**, New York City; **Walsh Construction Co.**, Davenport, Ia.; **Guy F. Atkinson Co.**, San Francisco; **W. E. Kier Co.**, San Diego; **Morrison-Knudsen Co.**, Boise, Idaho; **J. F. Shea Co.**, San Francisco; **MacDonald & Kahn Co.**, San Francisco; **Pacific Bridge Co.**, San Francisco; **Henry J. Kaiser Co.**, Oakland, Cal.; **Utah Construction Co.**, Ogden, Utah; **General Construction Co.**, Seattle.

Only one other bid, amounting to $43,185,802, was submitted by **Pacific Constructors, Inc.**, a combination including: **Griffith Co.**, Los Angeles, **Lawler & Maguire**, Butte, Mont.; **Shofner, Gordon & Hinman**, Denver; **Metropolitan Construction Co.**, Los Angeles; **D. W. Thurston**, Pasadena, Cal.; **American Concrete & Steel Pipe Co.**, Los Angeles; **Hunkin & Conkey**, Cleveland, Ohio; and **L. E. Dixon Co.**, Los Angeles.

At this writing no official announcement of the award of the contract has been made.

For completing tunnel control shafts and for installing gates and appurtenances at Fort Peck dam in Mont., contract for $1,876,922 was awarded by U. S. Engineer Department to **Fegles Construction Co., Ltd.**, of Minneapolis, Minn.

WATERWORKS

Successful bid of $669,549 for distribution system at St. Francis, Wis., was submitted by **Wenzel & Henock Co.**, of Milwaukee. At Augusta, Ga., **Batson Cook Co.**, of West Point, Ga., is building a $245,715 waterworks unit; second unit went to **McDougald Construction Co.**, of Atlanta, for $107,534; two sedimentation basins were bid in by **Smith-Pew Construction Co.**, of Atlanta, for $198,530. **W. W. Magee**, of St. Paul, Minn., has a $198,200 water main contract in that city.

BRIDGES

Bridge approach and grade crossing in the Bronx, New York City, was bid in by **J. Leopold & Co.**, for $1,221,427. Low bidder for Mississippi River bridge superstructure at LaCrosse, Wis., was **Klug & Smith Co.**, of Milwaukee, with tender of $509,621.

HIGHWAYS

Among state highway contracts awarded last month were the following: Mississippi: $259,173 for concrete paving to **Barber Bros. Contracting Co., Inc.**, of Baton Rouge, La.; $580,214 (three contracts) to **Harrison Engineering & Construction Corp.**, of Kansas City, Mo.; $334,334 to **Cobb Bros. Construction Co.**, of Meridian, Miss. South Carolina: $270,597 to **F. N. Thompson**, of Charlotte, N. C. Georgia: $188,288 to **Southern Roads Co.**, of Birmingham, Ala. New Jersey: $319,203 to **LaFera-Grecco Construction Co.**, of Newark N. J.; $307,951 to **Weldon Construction Co.**, of Westfield, N. J. New York: $238,186 to **A. I. Savin Construction Co.**, of East Hartford, Conn. Arkansas: $221,314 to **Koss Construction Co.**, of Des Moines, Ia. California: $329,038 for grading and tunnels to **Pioneer & Hinman**, of Denver, Colo.; $318,226 to **Matich Bros.**, of Elsinore, Calif.

WATERWAYS

Reconstruction of Columbia River north jetty in Washington, was awarded to **Columbia Construction Co.**, of Bonneville, Ore., for $1,179,183. In Louisiana, **Lewis-Chambers Construction Co.**, of New Orleans, received a $257,230 contract for canal levee. For excavation of New York State Barge canal low bid of $843,700 was received from **W. E. Callahan Construction Co.**, of Dallas, Tex. In Hollywood, Fla., low bid for dredging, amounting to $880,891, was received from **Arundel Corp.**, of Baltimore. At Presque Isle, Mich., **Polaris Concrete Products Co.**, is building $596,529 breakwater extension. Low bidder on channel improvements in Miami Harbor, Fla., was **Atlantic Gulf & Pacific Co.**, of New York, with price of $559,043. **McWilliams Dredging Co.**, of Chicago, received a $410,785 contract for dredging Illinois Waterway

BUILDINGS

Industrial — At Long Beach, Calif., **Ford J. Twaits Co.**, of Los Angeles, is building a $1,000,000 factory for Procter & Gamble Co. In Jersey City, N. J., contract for $300,000 factory for Westinghouse Co., went to **Barr & Lane**, of New York.

Public — For high school in Milwaukee, Wis., contracts aggregating $628,979 were awarded to **Kroening Engineering Corp.** of Milwaukee; structural steel on same job went to **Milwaukee Bridge Co.**, for $294,492; masonry work to **P. Riesens Sons**, of Milwaukee, for $291,000. Low bid of $984,400 for health institute building at Bethesda, Md., was submitted by **George A. Fuller Co.**, of Washington, D. C. **E. J. Pinney Co.**, of Springfield, Mass., submitted bid of $823,952 for high school at Rochester, N. H. **A. F. Blair**, of Lake Charles, La., is building a $496,775 high school at Port Arthur, Tex.

Commercial — A $1,000,000 store building for Sears-Roebuck & Co., is under construction at Baltimore, Md., by **Consolidated Engineering Co.**, of Baltimore. In Hartford, Conn., **Southern New England Contracting Co.** received $1,000,000 contract for store for G. Fox & Co., Inc.

Construction Methods and Equipment

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WILLARD CHEVALIER, Vice-President

JANUARY, 1938

The "How" of it

For the benefit of readers concerned with the practical application of method or equipment the following references are to articles or illustrations in this issue that tell:

How TRAFFIC INTERSECTION PROBLEM was solved by constructing elaborate "pretzel." — p. 41
How DE-AIRED BRICK was used to pave roadway of new Lincoln tunnel. — p. 44
How STRIKEOFF TEMPLET leveled sand-mastic cushion course for brick pavement. — p. 44
How ROLLING of brick pavement was done on planks. — p. 45
How RUBBER LATEX and asphalt were combined to form paving joint filler. — p. 47
How SUB-OILING of road was done with machine fitted with hollow drill teeth. — p. 48
How TRAVELING MIX PLANT laid bituminous road surface. — p. 49
How SOIL-CEMENT STABILIZATION prepared road base. — p. 52
How WIDE SPRINKLER BAR applied water to cement-stabilized road base. — p. 53
How DIVIDED-LANE SUPERHIGHWAY was surfaced with bituminous plant-mix. — p. 56
How VIBRATING FEEDERS delivered aggregate at uniform rate to stone elevator. — p. 57
How SELF-PROPELLED SPREADER laid bituminous mix. — p. 57
How MECHANICAL CHIP SPREADER distributed screenings on penetration surface. — p. 59
How GOLD was recovered from road gravel by western contractor's screening plant. — p. 61
How REINFORCEMENT of wire mesh was incorporated in bituminous surface on old concrete. — p. 62
How POWER SHOVEL mounted railway cars to unload paving material. — p. 62
How "PORCUPINE" ROLLER, with projecting "quills" worked down coarse aggregate. — p. 62
How CRIB WING WALLS make bridge widening easy and cheap. — p. 62
How GRADER ATTACHMENT regulated blade height for cutting shoulders. — p. 62
How BUILDING PAPER on subgrade conserved water in wet concrete. — p. 63
How COTTON FABRIC was laid on road by wheel-mounted roller. — p. 63
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How CONCRETE PAVEMENT was applied to wide city streets. — p. 64
How BITUMINOUS MACADAM paving practice is standardized in one state. — p. 65
How TWO PAVERS operated boom-to-boom to lay concrete pavement. — p. 70
How BATCH BOXES for paving concrete were hauled 17 mi. by trucks and trailers. — p. 70
How GRADE SEPARATION was accomplished with steel girder spans. — p. 74
How SAFETY is built into highways. — p. 76
How 34E DUAL-DRUM PAVER speeded production of concrete. — p. 78
How BRIDGE ROADWAY was paved with brick. — p. 82
How HEAVY GRADING was done with variety of machines. — p. 84

ROBERT K. TOMLIN, Editor — A. E. PAXTON, Manager

Editorial Staff: Vincent B. Smith, Paul Wooton (Washington), Nelle Fitzgerald

CONSTRUCTION Methods and Equipment was founded in 1919, under the name of SUCCESSFUL METHODS, by the Manufacturers Publicity Bureau, Inc., of Chicago, representing a group of non-competing manufacturers of construction equipment. Charles B. Thomas, editor of the first few issues, was succeeded by William Jabine.

In 1926 the McGraw-Hill Publishing Company, Inc., of New York, purchased the publication, changing its name to SUCCESSFUL CONSTRUCTION METHODS in November of that year, to CONSTRUCTION METHODS in May, 1927, and to CONSTRUCTION Methods and Equipment in December, 1936, in order more accurately to define its field and purpose.

All rights to the foregoing titles are reserved by the publishers.

Robert K. Tomlin was appointed editor of CONSTRUCTION METHODS in January, 1928. Vincent B. Smith is associate editor; Nelle Fitzgerald, assistant editor; and Paul Wooton, Washington representative.

The Fight for Federal Aid

AS THIS IS WRITTEN Congress has just adjourned its special session without acting on the President's recommendation to cancel the 1939 Federal Aid authorization. This means that the federal and state highway programs for 1938 and the first half of 1939 are assured.

All very well, so far as it goes. But everyone concerned with highway improvement will be wise to take warning from this parried threat and to guard against any repetition of it during the regular session which convenes in January.

To do this it will be necessary to bring home to the man on Main Street the truth about his highways in general and Federal Aid in particular. An important part of that job must be done by the American Road Builders Association, now about to meet in its annual convention, and by its chapters and affiliated groups throughout the nation. Incidentally, the recent emergency has been of real service to the highway industry in bringing out the value of close cooperation between a national highway association with Washington headquarters and affiliated state groups.

One noteworthy example of what a state group can do is the "Primer on Federal Aid to Highways," issued by the Highway Institute of Minnesota* It presents, in question and answer form, just the information that is needed to show the Minnesota citizen what Federal Aid means to him. It is to be hoped that similar information can be made available in every state. Just in proportion as there is nationwide appreciation of Federal Aid, will Congress be encouraged to stand firmly against further attack from any quarter.

THE CASE for Federal Aid is strong. It is in no sense a "pork-barrel"; it is just what its name implies — federal *aid*. No federal funds are spent unless they are matched dollar for dollar by state funds, and not even then until the states have first done the work and paid for it. The amount of the current authorization is not out of line with the increasing dependence of our people on the highways, and the allocation of the funds to states and projects is not contingent on log-rolling or political advantage. It is in accordance with a rigid formula, scientifically worked out. Then, too, the expenditure of both federal *and state* funds must be carried on under the specifications and supervision of the engineering staff of the Bureau of Public Roads, whose record as to competence and integrity is of the highest.

IT WOULD be difficult, if indeed it be possible, to cite any other form of federal expenditure that meets so fully these high specifications:

1. Federal Aid is not an administrative expense; it is an investment in a balanced nationwide highway system that is a national asset of the first magnitude.
2. It has helped to maintain the routing, design, construction and maintenance of our entire highway system — state and local as well as federal — on the highest plane of engineering and efficiency.
3. It touches directly the lives of more of our people than does any other federal expenditure.
4. By contributing to the stability of highway development, which is the first essential of motor transportation, it helps directly to maintain employment for the 6-million workers in its dependent industries, i.e., one out of seven of all those gainfully employed.
5. It contributes directly to increased highway safety via the only channel through which the federal government can do very much about it.
6. And finally, through federal excise taxes on automotive products, directly contingent on highway usage, it generates a revenue that constitutes 75 per cent of all the federal excise taxes and *exceeds by many millions of dollars the Federal Aid expenditures.*

Because of these distinctive, if not unique, qualities of Federal Aid, it should be one of the last items to be touched in the interest of federal economy. If the American people can be made aware of them, there need be no fear of any raid to unload the burden of budget-balancing on the highway user, who already contributes far more than his share of the federal revenues.

But it is up to those who know all this to see that the people know it too.

Willard Chevalier

* 335 Plymouth Building
Minneapolis, Minnesota

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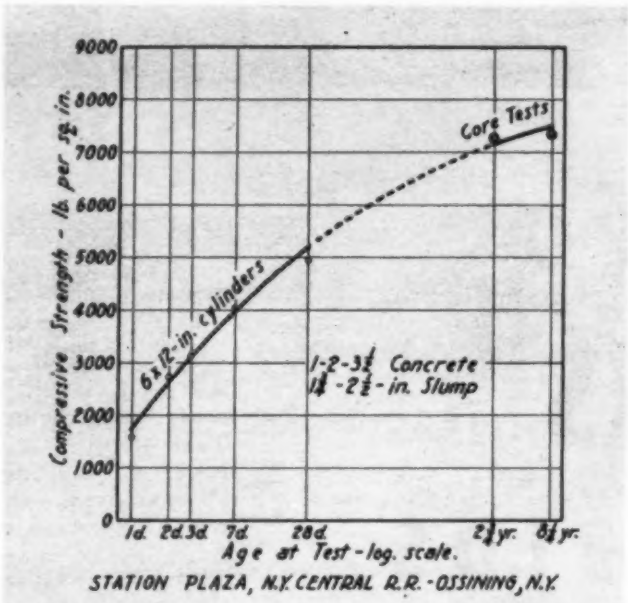
THIS 10-YEAR RECORD SPEAKS FOR ITSELF



STATION PLAZA, N.Y. CENTRAL R.R. - OSSINING, N.Y.

TEN years ago, the makers of Lone Star Cement pioneered in the introduction of a true Portland cement, 'Incor', which cures or hardens thoroughly in one-fifth the usual time. Pre-tested first in the laboratory and then in the field, the strength and durability of 'Incor' were amply demonstrated, before a single barrel was ever marketed.

But engineers and contractors have to be fact-minded — they expect "to be shown." So, in order to provide first-hand service data, the oldest 'Incor' jobs have been examined periodically. After five years, a survey was published. Now, a 10-year condition survey is presented for the information of cement users. Here is a typical 'Incor' service record:

Cold-Weather Results

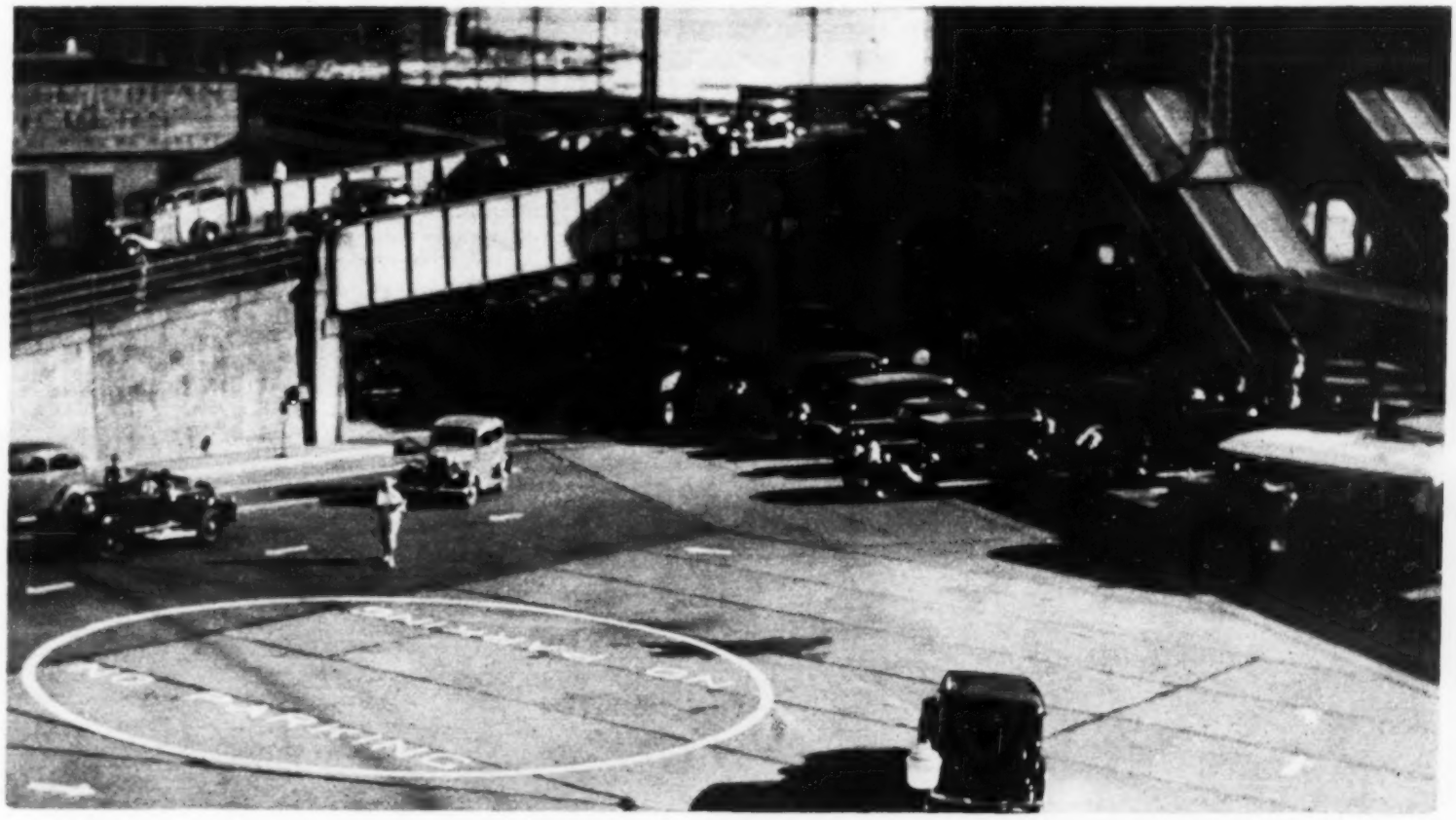
Ossining, N. Y., Station Plaza (below) was repaved in 1928. Nights were cold, but concrete was opened to traffic in 24 hours. Present condition: sound as opening day. Diagram (left) shows high ultimate strength, too.

Further proof that it pays to use 'Incor'* on jobs where dependable high early strength shows a profit. Write for copy of "After Ten Years." Lone Star Cement Corp., Room 2293, 342 Madison Ave., New York.

*Reg. U. S. Pat. Off.

LONE STAR CEMENT CORPORATION

MAKERS OF LONE STAR CEMENT...'INCOR' 24-HOUR CEMENT



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and PRODUCTION COSTS

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challenge to every operat
who faces the problem
"guessing right." Startin
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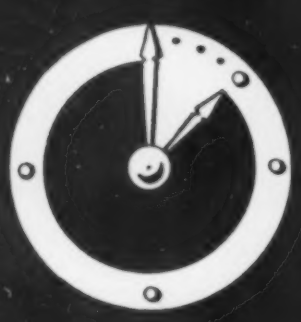

TRAC-TRUKS *Excel on*

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SOME OF THE REASONS *Why* TRAC-TRUKS *are More Successful*

Top performance and continued endurance of Trac-Truks are the natural results of their advanced principle of design—pioneered and perfected by Euclid—their wealth of built-in material ruggedness and their greater facilities for doing more and better work.

Greater Hauling Capacity — One primary reason for more economy in hauling with Trac-Truks is their larger capacity—up to 15 cu. yds.—providing for more pay dirt in proportion to gross load because of their semi-trailer principle with better weight distribution.

More Flotation and Speed—The use of big tires is an important factor in producing the finer performance of Trac-Truks in borrow pits—over haul roads and on soft hills. They not only travel more securely in soft places but also move faster with their extensive rolling radius contributing to greater speed.

Higher Power Efficiency—Equipped with high powered six cylinder motors, Trac-Truks are capable of delivering greater efficiency for all heavy pull emergencies and operate with surprisingly low fuel consumption. They handle difficult job conditions more satisfactorily and move their loads faster, thus making better hauling cycle time.

Minimum of Maintenance—In keeping with Trac-Truk stellar performance is their standard of quality in design and construction which enables them to do better work more days in the year and render a greater paying investment to the owner. Being the originator and pioneer of this type of dirt moving unit and having the knowledge of this experience, Euclid engineers have learned what built-in stamina and sturdiness are required to reduce up-keep costs and add to operating profits.

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NOW STANDARD ON EUCLID'S TRAC-TRUKS

With the adoption of genuine Westinghouse Air Brakes as standard equipment, Euclid Road Machinery Company places its Trac-Truk on the constantly growing roll of safe, positive, economically controlled vehicles • In selecting the Bendix-Westinghouse Automotive Air Brake Company to furnish this time-tested equipment, the Euclid Road Machinery Company avails itself not only of the world's finest, most dependable brake but a nation-wide service, founded on more than a half century of research and development, and dedicated to the safe, swift, more economical movement of modern transport vehicles • Genuine Westinghouse Air Brakes are available in types designed especially for the lightest to heaviest motor unit.

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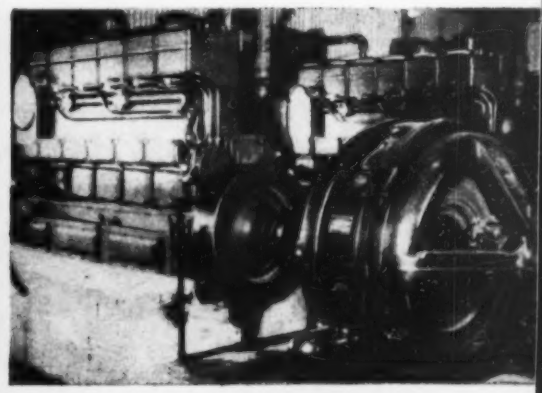
Get your FREE copy of this book at Cleveland or write for it today. A shovel, dragline, compressor, pump, or rock crusher powered by a Cummins Dependable Diesel *is* "Powered for Profit." Cummins Engine Co., 1703 Wilson St., Columbus, Indiana.

ON DISPLAY AT CLEVELAND

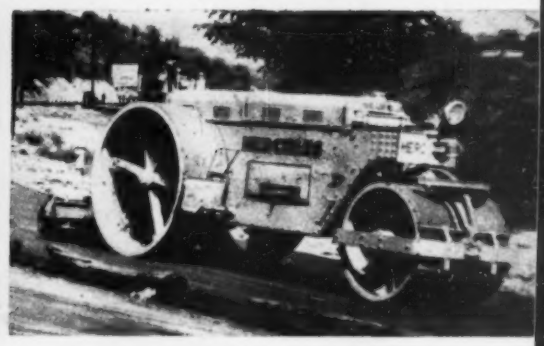
The new locomotive Model, VL-12, 500 hp., weighs only 13,000 lbs., now in production.

MODEL L-600
Morrison-Utah-General Corporation purchased three for generating on Keystone Dam project.



MODEL HB-600
Guthrie, Marsh and Peterson operate nineteen of these.

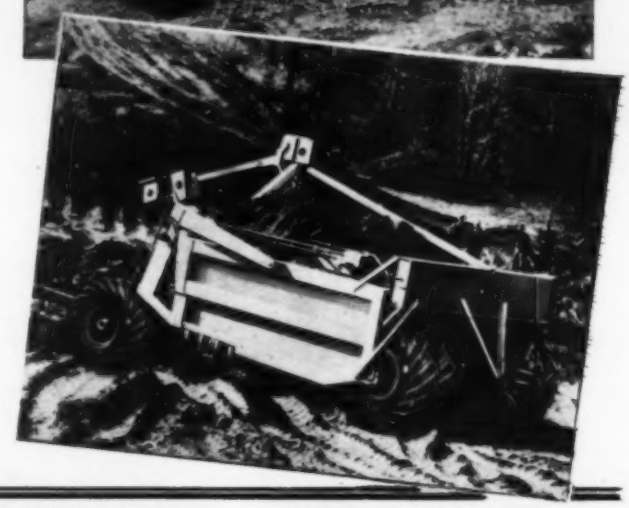
MODEL HB-400
See installation in Minneapolis-Moline Tractor and Osgood Road Roller.



CUMMINS *Dependable* DIESEL

PIONEER IN MODERN DIESEL DEVELOPMENT

4 ways TO CUT DIRT-MOVING COSTS



FIRESTONE builds four *different* Ground Grip Tires for the construction field, each a master of its job, — each built with the patented Ground Grip traction tread, Gum-Dipped Cord body, extra layers of Gum-Dipped cords under the tread, and other *exclusive* Firestone features.

GROUND GRIP EARTH MOVER. A giant, low-pressure tire for all drawn types of dirt-moving equipment operating in loose earth or fill.

GROUND GRIP EXCAVATOR. A great *traction* tire for rocky ground. Resists snagging and cutting. Guards against impact breaks. Wears longer.

GROUND GRIP HEAVY DUTY. The *greatest traction tire* ever built. Increases tractive power in earth and soft fill. Tough tread gives long wear.

GROUND GRIP ROAD BUILDER. A rugged, cut-resisting traction tire for motor graders. Gives more power at the blade.

Start today to reduce costs by using Ground Grip Tires on all your equipment. And for greatest economy and performance, specify *Firestone Ground Grip Tires* when ordering *new* earth-moving equipment.

GROUND GRIP EARTH MOVER | **GROUND GRIP EXCAVATOR** | **GROUND GRIP HEAVY DUTY** | **GROUND GRIP ROAD BUILDER**

Firestone GROUND GRIP TIRES

MORRISON-KNUDSEN
COMPLETES ANOTHER DAM
in record time!

In the construction of the Roy B. Inks Dam, New Texaco Motor Oils, Havoline and Marfak were used for cars and trucks, Crater for wire rope and exposed gears. Texaco Ursa Oil for the Diesel tractors, Algol and Alcaid for compressors.

THIS PROJECT on the Colorado River, 12 miles from Burnet, Texas, is an example of speed and efficiency in engineering construction.

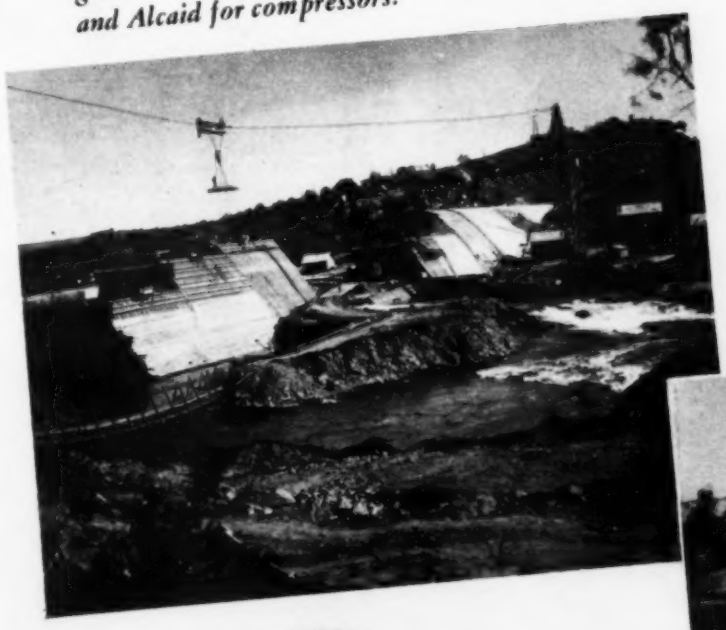
The dam is 1,557 feet in length with maximum height above bed-rock of 78 feet. The non-overflow section is 112 ft., spillway 870 ft. More than 120,000 barrels of cement, 56,000 cu. yds. of sand and 104,000 cu. yds. of crushed stone were used.

The Morrison-Knudsen Company reported that lubrication was an important factor in this proficiency . . . kept equipment running continuously, lowered cost of maintenance, eliminated breakdowns.

The lubricants used were TEXACO . . . the contractors putting it up to Texaco lubrication engineers to supply them with the proper lubricants needed for the job.

Trained lubrication engineers are always available for consultation on the selection and application of Texaco Lubricants. Prompt deliveries assured through 2108 warehouse plants throughout the United States.

The Texas Company, 135 East 42nd St., New York City.



TEXACO

TEXACO *Industrial Lubricants*

The World Over . .

South Africa (Above) The world travels in comfort over thousands of miles of beautiful roads, simply because Cletracs have the power that makes good roads economically possible. Here is a Cletrac grading and maintaining a road in South Africa.

United States (Right) A Cletrac Model FD and a three wheeled Austin-Western 12-inch blevband grader cutting a cut 36 inches deep in a heavy clay soil with a three- or four-inch layer of limestone.

Georgia (Below) One of a pair of Model D Diesel Cletracs in Hart County, Georgia, that is moving 50 to 75 yards of pay dirt per unit per hour, depending upon the length of the haul. Like all Cletrac Diesels it has electric starting.

Argentina (Below) In the building of a s stretch of road between Ju and Gonzales, there were 700,000 cubic yard dirt to be moved. Like similar jobs in the Un States, the work was done with Cletracs.

England (Above) Travelers tell of the wonderful roads of England. Here's a new one under construction with the aid of a Cletrac. The world over, wherever there's work to be done, you'll find Cletracs.

California (Left) Through the heart of a Red wood Forest at Crescent City, goes a 9½-mile road, graded with Cletracs and scrapers. Tota cost was $690,000 and required 670,500 yards of grading

Cletrac
Crawler Tractors

Diesel, Tractor Fuel, Gasoline . . . Six Sizes

It's Cletrac for Low Cost Road Work

In the virgin countries of the North . . . under the burning sun of the tropics . . . down under the Southern Cross . . . in Europe, Asia, Africa, South America . . . wherever there are highways to be built . . . roads to be maintained . . . snow to be removed . . . WORK to be done, you'll find Cletrac Crawler Tractors.

Cletracs do a more economical job for many reasons. With their balanced design they give better traction . . . they have greater ability to keep the job moving. With their controlled differential steering, they have greater power on the turns . . . both tracks are pulling at all times.

Check the Cletrac for your job. Check costs . . . speed of doing the work . . . ability to stay on the job until the work is done. You'll choose Cletracs. There's a size for every job, from 22 to 94 horsepower, including the new 28 horsepower Diesel—the smallest Diesel crawler available.

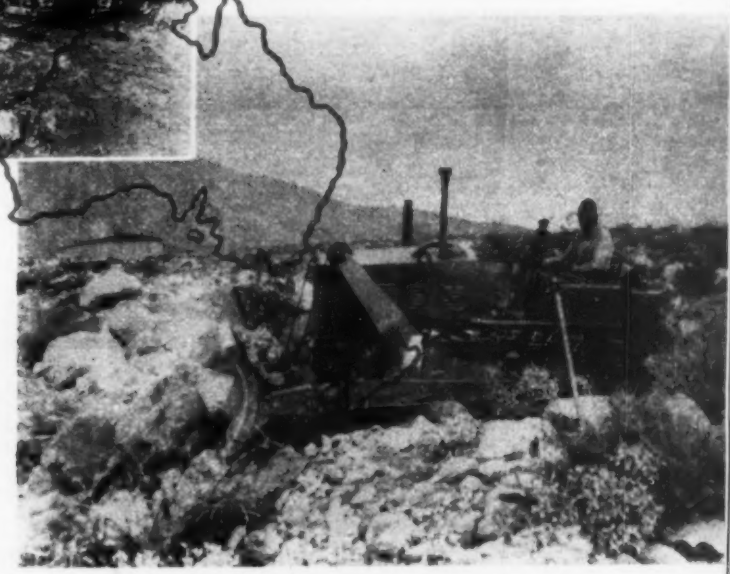
THE CLEVELAND TRACTOR COMPANY
SAN FRANCISCO BRANCH: 2660 HARRISON STREET
Distributors in more than 125 principal cities

Mexico (Below) North from Mexico City to Laredo, Texas, winds the Trans-American Highway, one of the most scenic drives in the world. Thanks to Cletracs you can ride it in comfort.

Austria (Right) Austria wants more tourist trade. Here is a Cletrac hauling materials for grading the new "Glocknerstrasse," a government sponsored 80-mile highway pass between Austria and Switzerland.

Switzerland (Above) Two thousand years ago Julius Caesar led his legions into Switzerland through the pass which today bears his name. But only a few years ago was the Julier Pass kept open in winter. It was this Cletrac which did it.

California (Below) "The toughest trail-building job they've ever seen," is the comment of those who saw this Model D Diesel Cletrac at work at Palm Springs. But Cletracs have what it takes.



New South Wales (Right) Where his Cletrac is loosening up the ground for grading, will soon run a beautiful new highway which the Main Roads Board of New South Wales is building near Kyogle, not far from the Queensland border.

Cletrac
Crawler Tractors
Built To Endure

The only tractors with controlled differential steering that keeps both tracks pulling at all times . . . on the turn as well as on the straightaway.

Fifteen Models . . . 22. to 94. Horsepower

BUILT FOR SPEEDY WORK...

Modern equipment performs better with Gulf lubricants and fuels

THE DIRT FLIES when modern equipment like this goes to work on a job.

And it *must move fast* — or profits fail to materialize. A big investment in costly equipment won't pay dividends when the work is interrupted for adjustments and repairs.

But it needn't be — if all equipment gets the right lubricants, properly applied at the proper intervals. And contractors don't have to pay a premium for this kind of insurance against operating troubles.

From Maine to Texas, Gulf offers contractors the cooperative service of trained lubrication engineers who are prepared to recommend the best lubrication practice for every type of equipment. From a broad line of more than 400 quality oils and greases, the Gulf engineer selects the lubricant which is exactly suited to each requirement — and then suggests the best method of application.

This careful attention to lubrication is the best insurance you can buy against operating interruptions and repair expense. A Gulf engineer is always at your service.

Gulf Oil Corporation GULF INDUSTRIAL LUBRICATION **Gulf Refining Company**

GENERAL OFFICES: GULF BUILDING, PITTSBURGH, PA.

ANOTHER *Smaller Northwest*

for H.W. HOLT COLUMBUS OHIO

HERE'S another repeat order for a Northwest ¾ yd. shovel, making three smaller Northwests for this Columbus contractor and a total of seven Northwests purchased over a period of 10 years.

The combination of the cast steel base with cast side frames and the cushion clutch means freedom from trouble and longer life. Add to this the "feather-touch" clutch control and ventilated, uniform pressure swing clutches and you have sensitive control and easy operation. Finally, with high engine power and the Northwest Independent Crowd that utilizes force other shovels waste, you have extra digging power that can handle jobs that other machines of the same rating can't handle. These things have proved the superiority of the smaller Northwests in the field and are the reasons why they are being bought again and again by satisfied customers.

H.W. Holt has owned 7 Northwests in 10 years

NORTHWEST ENGINEERING COMPANY
1728 Steger Building 28 East Jackson Boulevard Chicago, Illinois

NORTHWEST

Connecticut River Bridge from Hanover, N. H., to Norwich, Vt.

Engineer: J. W. Childs.

Contractor: Davison Construction Co., Manchester, N. H.

THE COFFERDAM WAS SEALED WITH *Quick Service Concrete*

Quick curing of concrete has advantages in all seasons—especially so in winter. Concrete that cures and hardens to SERVICE STRENGTH QUICKLY often meets emergencies in winter. It lessens the chance of concrete freezing, reduces heat-curing costs, saves on forms, and "speeds up" the job.

On this bridge at Hanover, N. H., a prolonged sudden rise in temperature to 40° in February, a threatened thaw and ice jam imperiled the contractor's entire winter's work. Cofferdams had to be sealed—quickly. By using Lehigh Early Strength Cement with water and aggregates heated to 120° to 140°, the concrete cured and hardened in 48 hours. Used in the last pier, steel erection followed immediately. And again in the bridge deck, traffic was permitted on concrete 5 days sooner.

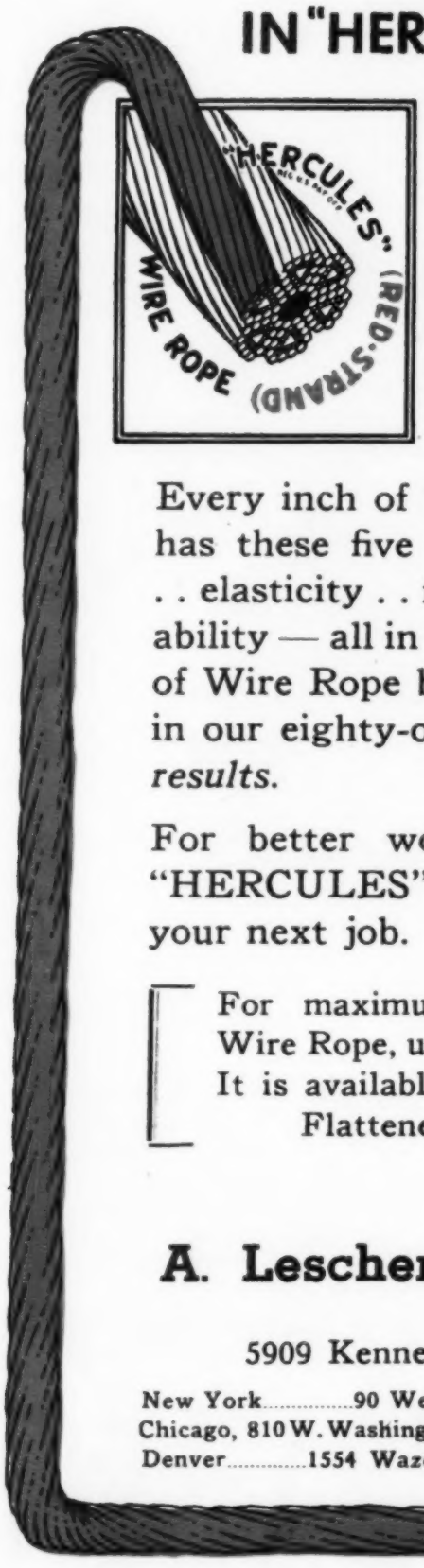
Each job has its own problems. QUICK SERVICE CONCRETE may aid in their solution. Made with Lehigh Early Strength Cement, under the same conditions, it compares in strength in 24 to 48 hours with normal portland cement concrete at 7 days. Consult the Lehigh Service Department on the advantages of Lehigh Early Strength Cement for any specific use. Ask for cold weather bulletin.

LEHIGH PORTLAND CEMENT COMPANY, Allentown, Pa., Chicago, Ill., Spokane, Wash.

LEHIGH EARLY STRENGTH CEMENT

Balanced—All FIVE

IN "HERCULES" (RED STRAND) WIRE ROPE



The reasons users get so much extra service out of "HERCULES" (Red-Strand) Wire Rope are because we put so much into it.

Every inch of "HERCULES" (Red-Strand) has these five essential features — strength . . elasticity . . flexibility . . toughness . . durability — all in perfect balance. A superiority of Wire Rope building that we have learned in our eighty-one years of concentrating on *results*.

For better work and real economy, try "HERCULES" (Red-Strand) Wire Rope on your next job.

For maximum efficiency in Preformed Wire Rope, use Preformed "HERCULES". It is available in both Round Strand and Flattened Strand constructions.

Made Only By

A. Leschen & Sons Rope Co.

ESTABLISHED 1857

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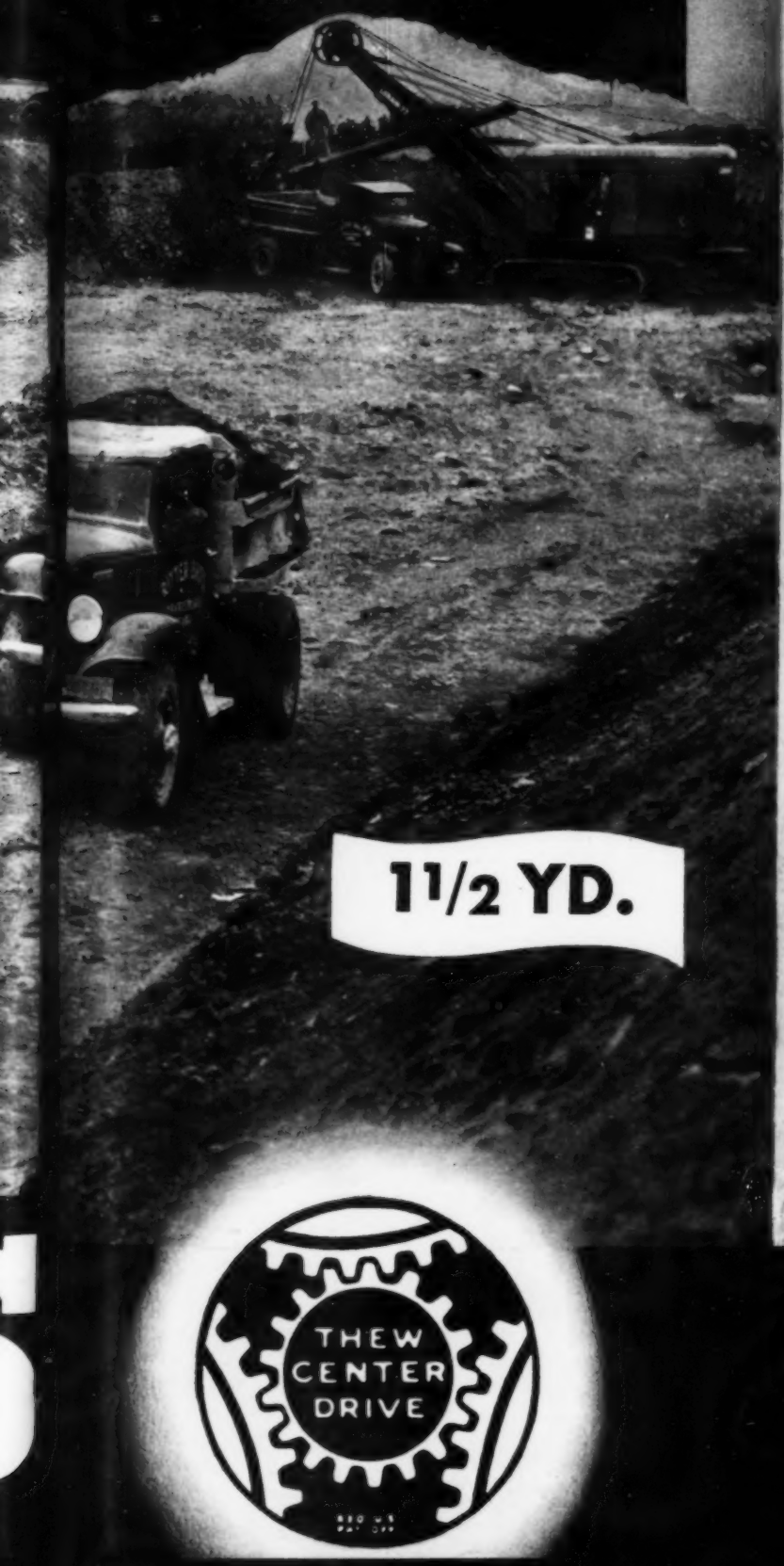
LOOK TO LORAIN for Lowest Cost Dirt in '38

LORAINS

This goes for rock or dirt with any Lorain from 3/8 to 2 cu. yd.

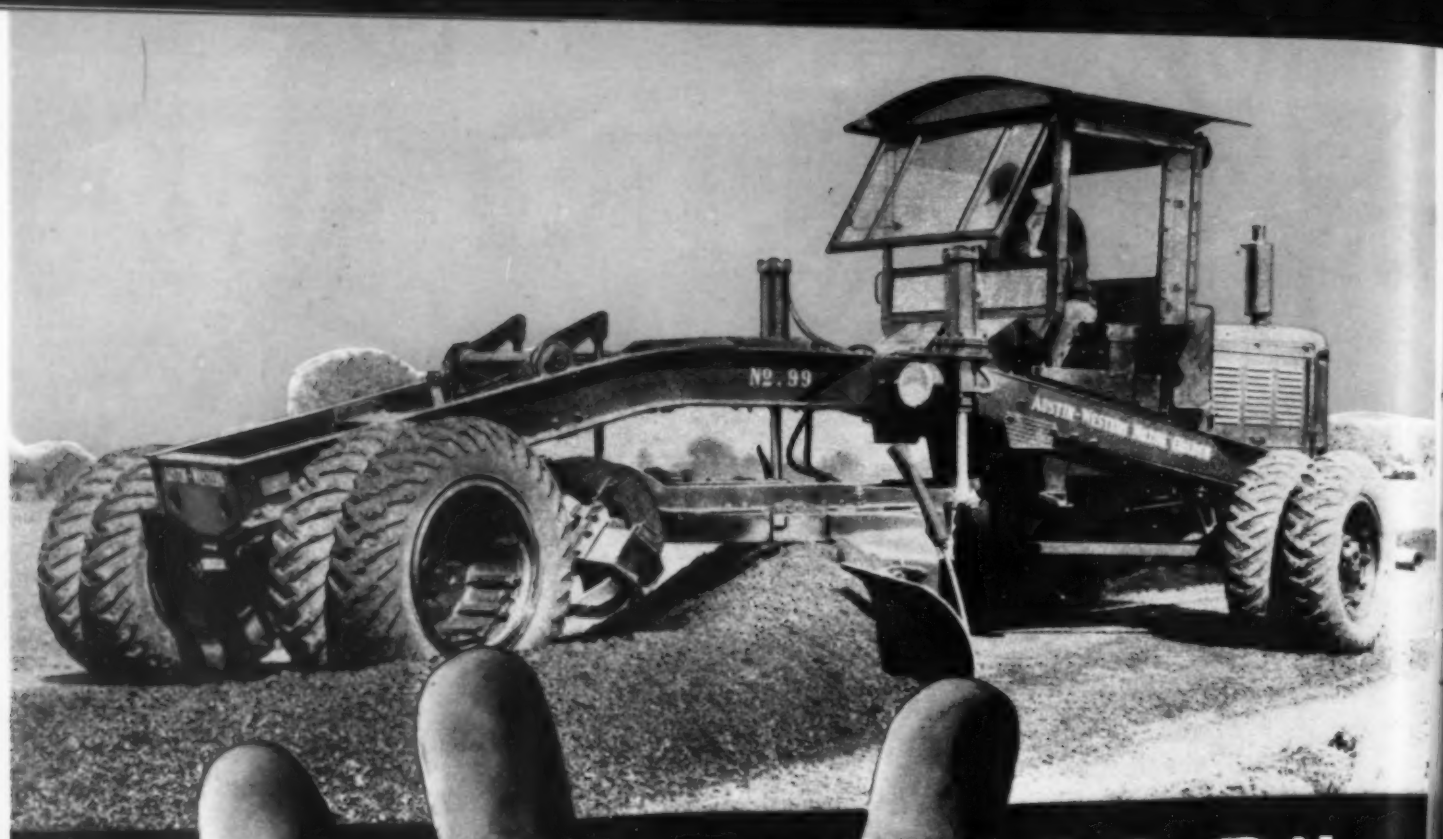
Write for catalogs describing this modern line of shovels and cranes.

THE THEW SHOVEL COMPANY
LORAIN, OHIO



1 1/2 YD.

THEW CENTER DRIVE



DRIVES & STEERS ON

all 4 wheels

AUSTIN-WESTERN 99 MOTOR GRADER

6 Basic Performance-Improving Features

1. ALL-WHEEL DRIVE
2. ALL-WHEEL STEER
3. CONTROLLED TRACTION
4. STABILIZED FRAME
5. PRECISION SIDE SHIFT
6. FULL HYDRAULIC CONTROLS

Big Horn County, Montana: The entire job including grading, ditching and back-sloping was performed by the "99".

This perfect slope has been made in one pass of the "99" Motor Grader.

THE GREATEST MOTOR GRADER *Ever Built*

THE NEW "99" MOTOR GRADER EXCEEDS *ALL* PREVIOUS STANDARDS OF PERFORMANCE

Discard all ideas of maximum possibilities in motor grader capacity and stamina. The A-W "99" . . . embodying All-Wheel Drive, All-Wheel Steer, Controlled Traction, Stabilized Frame, Precision Side Shift, and other equally revolutionary features . . . will handle countless jobs far beyond the capabilities of conventional motor graders—handle many jobs a motor grader has never done before.

All-Wheel Steer: The "99" can turn around on a thirty-foot grade in ⅓ the time required by conventional machines, backing up only once. It works around the sharpest "S" curves without stopping, because front and rear wheels can be steered separately, or in unison, in the same or opposite directions, and the operator can control his cut easily and surely.

On heavy maintenance and oil mix, frame can be offset so that the front wheels travel inside the windrow, giving the operator a full and unobstructed view of the work.

All-Wheel Drive: The "99" will move a heavier load on the blade and move it farther. It will plow deeper ditches and cut straighter ditch lines. With power delivered to every wheel it can operate in sand, wet clay, mud—where a conventional machine would bog down completely.

Controlled Traction: One reason for the extraordinary output of the "99" is its ability to make full use of its Four Wheel Drive Traction, on every class of work.

When moving a load on the blade, the operator places the front wheels directly ahead of the heel of the blade, and the rear wheels behind the toe. In this offset position, the pull of the front wheels and push of the rear wheels fully counteract the side thrust of the material on the blade.

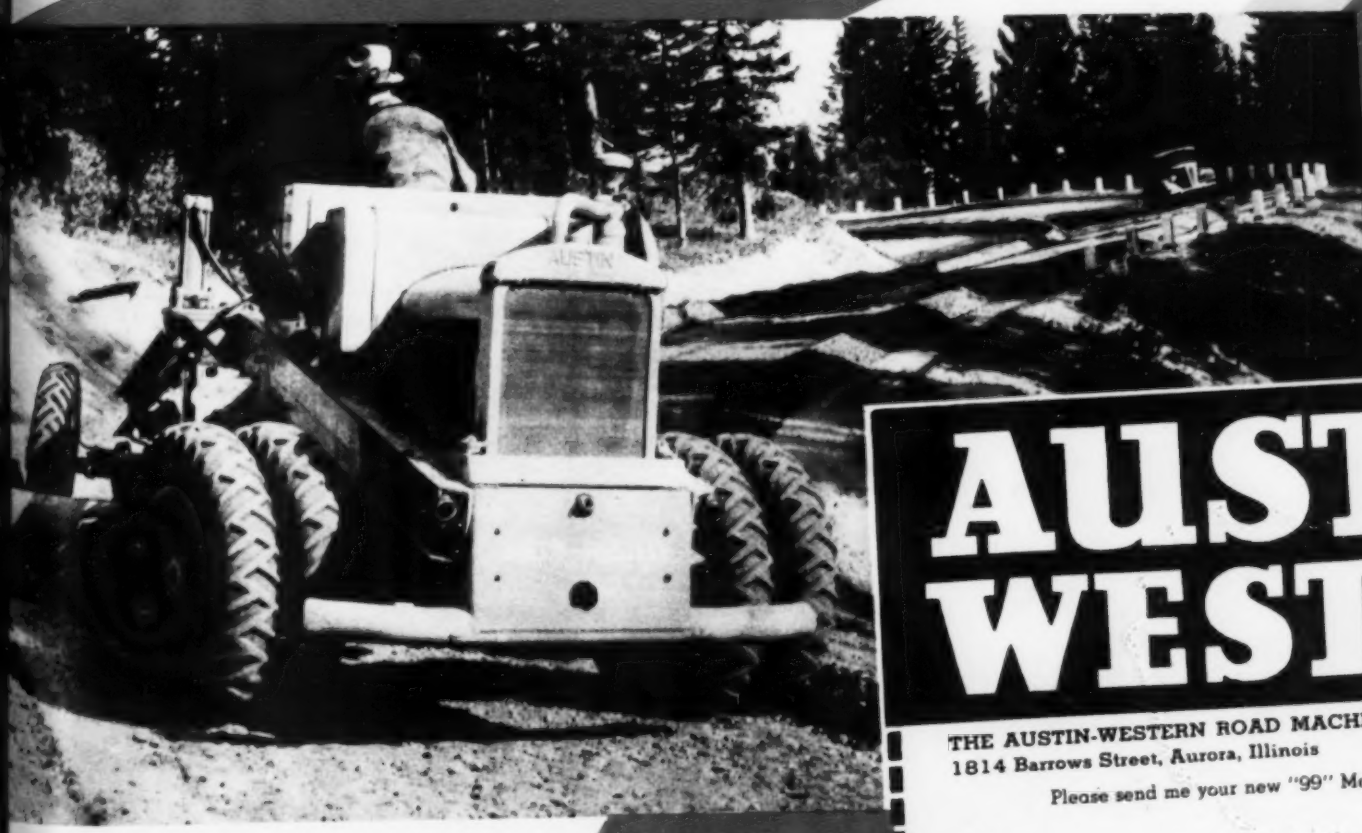
Stabilized Frame: The design of the "99" eliminates frame twist. The blade holds the floor of the road, even on 30 degree curves—no gouging at the toe or wasting at the heel of the blade.

Precision Side Shift: The operator can shift the blade under the heaviest load without changing the blade angle and without gouging. The circle remains in its fixed position—the blade slides on the arms by hydraulic power. This sliding action of the blade side shift keeps the entire blade on the floor of the road whether on a super-elevated curve, in a ditch or on any other work.

The "99" is the most useful machine on any highway job. In addition to the regular work of grading, ditching, oil mix, scarifying, its extra stability and traction make it an effective fast stepping tractor unit for snow plowing and bulldozing, for pulling a blade grader or sheep's foot roller and many other jobs.

Write or mail the coupon for Catalog No. 1710 showing the time and money saving features of the greatest motor grader ever built

The Austin-Western Road Machinery Co., Aurora, Ill.



This perfectly finished super-elevated curve shows how simply and effectively the "99" works. Note how the blade is reaching out for the windrow—no gouging or wasting, no stops for blade adjustments.

AUSTIN-WESTERN

99MG801

THE AUSTIN-WESTERN ROAD MACHINERY CO.
1814 Barrows Street, Aurora, Illinois

Please send me your new "99" Motor Grader Catalog No. 1710.

Name .....

Address .....

City ..... *State* .....

see the NEW
KOEHRING
dual drum
34-E
PAVER
at the ROAD SHOW
KOEHRING
HEAVY DUTY
Increased batch capacity and almost double the possible number of batches per hour are reasons responsible for the high production records established by the NEW Koehring Dual Drum 34-E Paver. Proven performance on many jobs is the record of this newest Paver now presented to paving contractors, as the latest contribution by Koehring to highway paving progress. See this most modern Paver at the Road Show, or write for bulletin giving complete information.
KOEHRING COMPANY
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—It goes to show

NOVO

ROAD PUMP — PRESSURE PUMP

BUILDERS HOIST — 6" SELF PRIMER

2" SELF PRIMER — NOVO BREAKER

What you will see at the Cleveland Road Show. It's Booth C-18.

Here you have a pre-showing of a corner of the Novo Booth, which we hope will be the meeting place for all of you at the Show.

If you can't be there, send for literature on the improved Road Pump, Pavement Breaker, Self-Priming Centrifugal Pumps, and Power Units.

BUY NOVO and keep abreast of PROGRESS

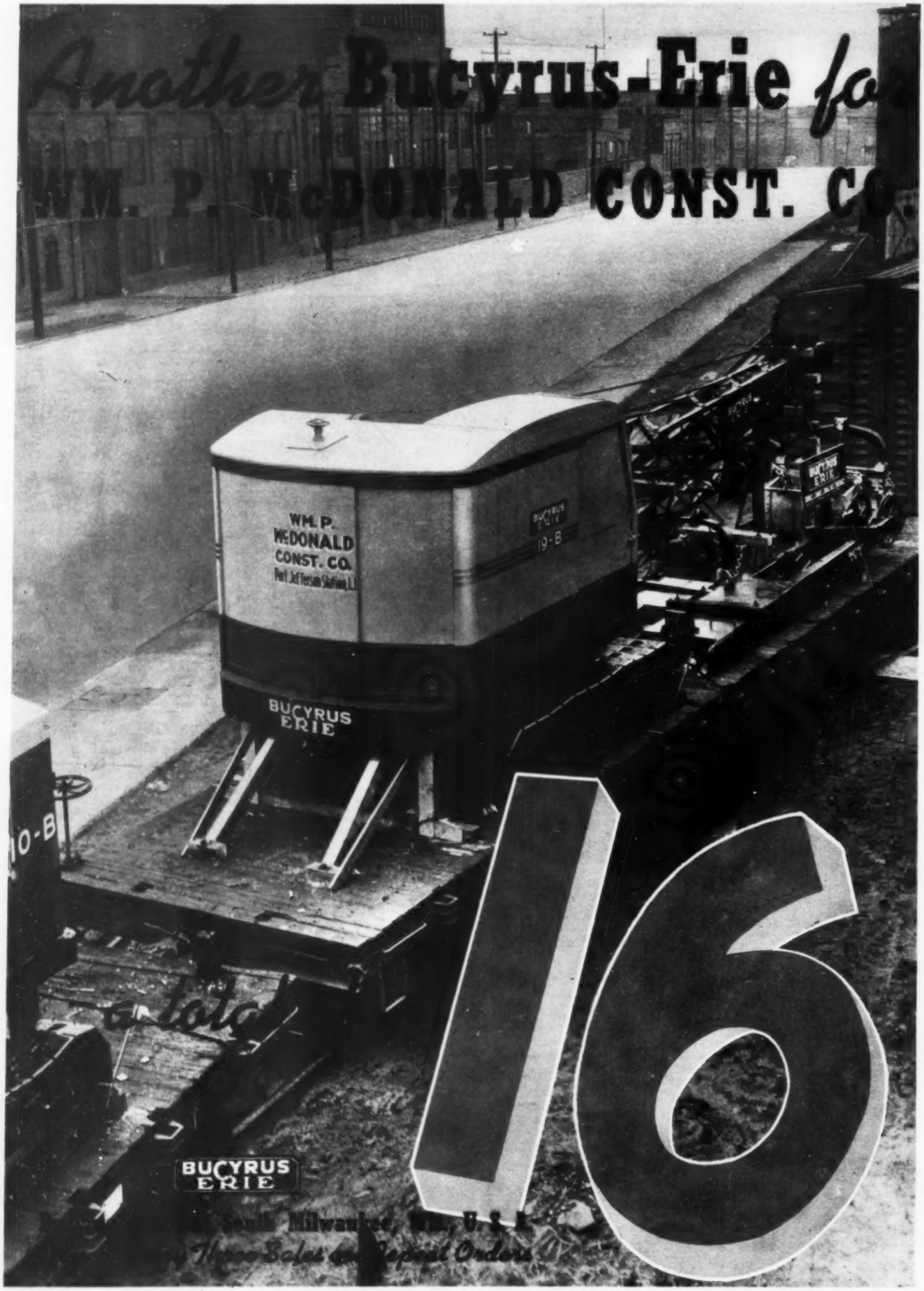
NOVO ENGINE COMPANY, LANSING, MICH.

ROAD PUMP

NOVO

STREAMLINER

POWER UNIT


Another Bucyrus-Erie fo
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ERIE
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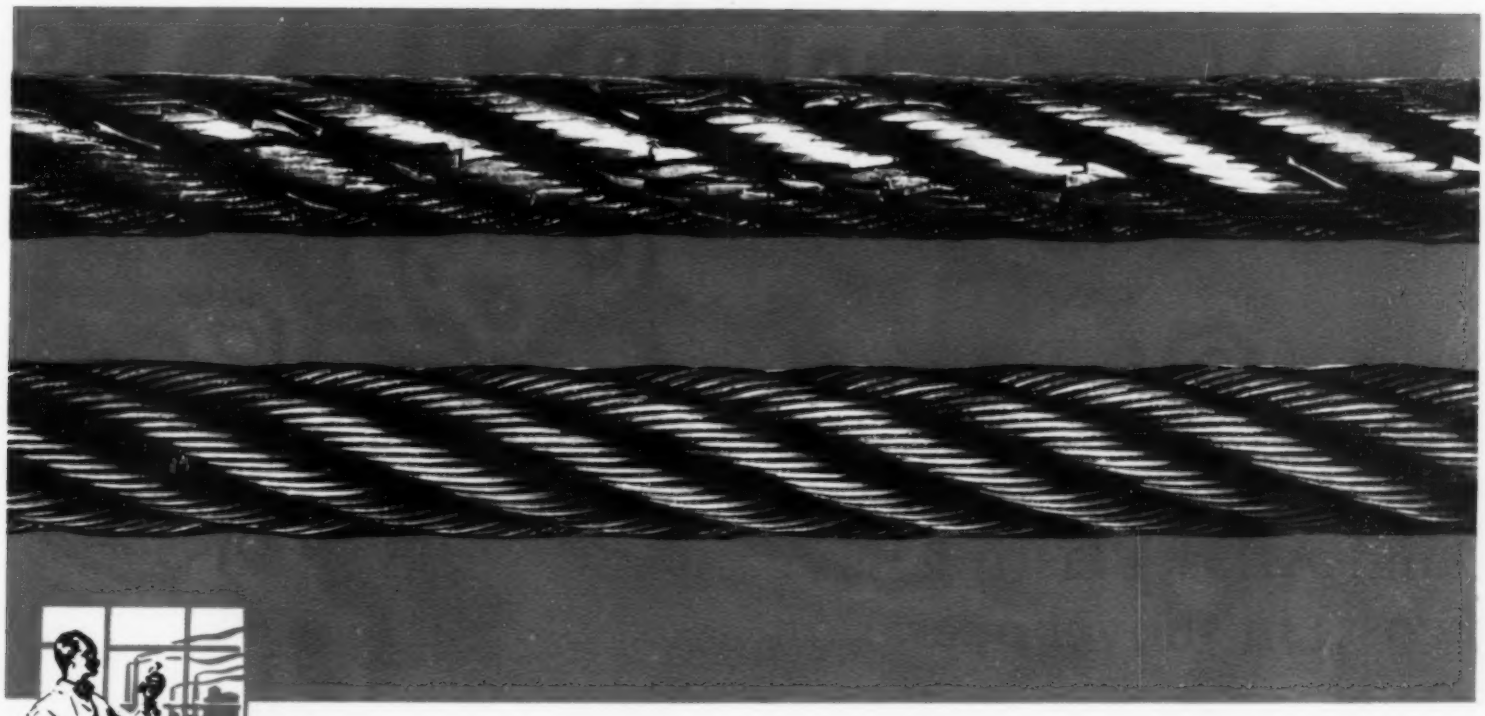
Quality BEYOND *Specifications gives* EXTRA ROPE LIFE



Official specifications have done much to bring up the general quality of wire rope . . . but such specifications only set minimum standards. It is still the privilege of the progressive wire rope manufacturer to build the longest possible life into his rope by adding quality beyond specifications. It requires wide experience, extensive laboratory equipment and extreme care in checking and testing during manufacture.

Wickwire Spencer offers a special rope for every purpose that will give longer life because it is built beyond specifications. Let us tell you of the rope designed for your service.

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WICKWIRE SPENCER STEEL COMPANY, *General Offices:* 41 East 42nd Street, New York. *Sales Offices and Warehouses:* Worcester, New York, Chicago, Buffalo, San Francisco, Los Angeles; *Export Sales Dept.:* New York.

WICKWIRE SPENCER SALES CORPORATION, New York, Chattanooga, Tulsa, Portland, Seattle.

WIRE ROPE
by Wickwire Spencer

Wickwire Spencer also manufactures all sizes and types of Wire Rope in Wisscolay.

WICKWIRE SPENCER STEEL COMPANY
41 East 42nd St., New York City

Please send me my free copy of your popular, new money saving manual, "Know Your Ropes".

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. . . Atlas Explosives and Atlas Blasting save costs in shovel operation

Shovels move rock more economically when you team them up with Atlas explosives and Atlas methods. They sing as they swing—and they never "sing the blues." For good blasting insures full bucket-loads—keeps trucks moving—and takes those new roads *to town* with greater speed and with greater economy!

The right dynamite does so much on the job—and costs so little in proportion to the work it does.

ATLAS GELODYNS for example! Here are explosives that give Gelatin performance at lower costs—tremendous power per dollar of expenditure—only slightly lower moisture resistance than Gelatins! Time and time again Gelodyns can be substituted for ammonia gelatins *stick for stick.* And—*there are twenty-five extra cartridges* (1¼" *x* 8") *of Gelodyn No. 3 to a fifty-pound case.*

Contractors everywhere know that explosives are "key" factors in construction jobs. And—they'll tell *you* that Atlas has the right explosive and the right method for any job!

Consult the Atlas Representative nearest you.

ATLAS POWDER COMPANY, WILMINGTON, DEL.

Cable Address—Atpowco

Everything for Blasting

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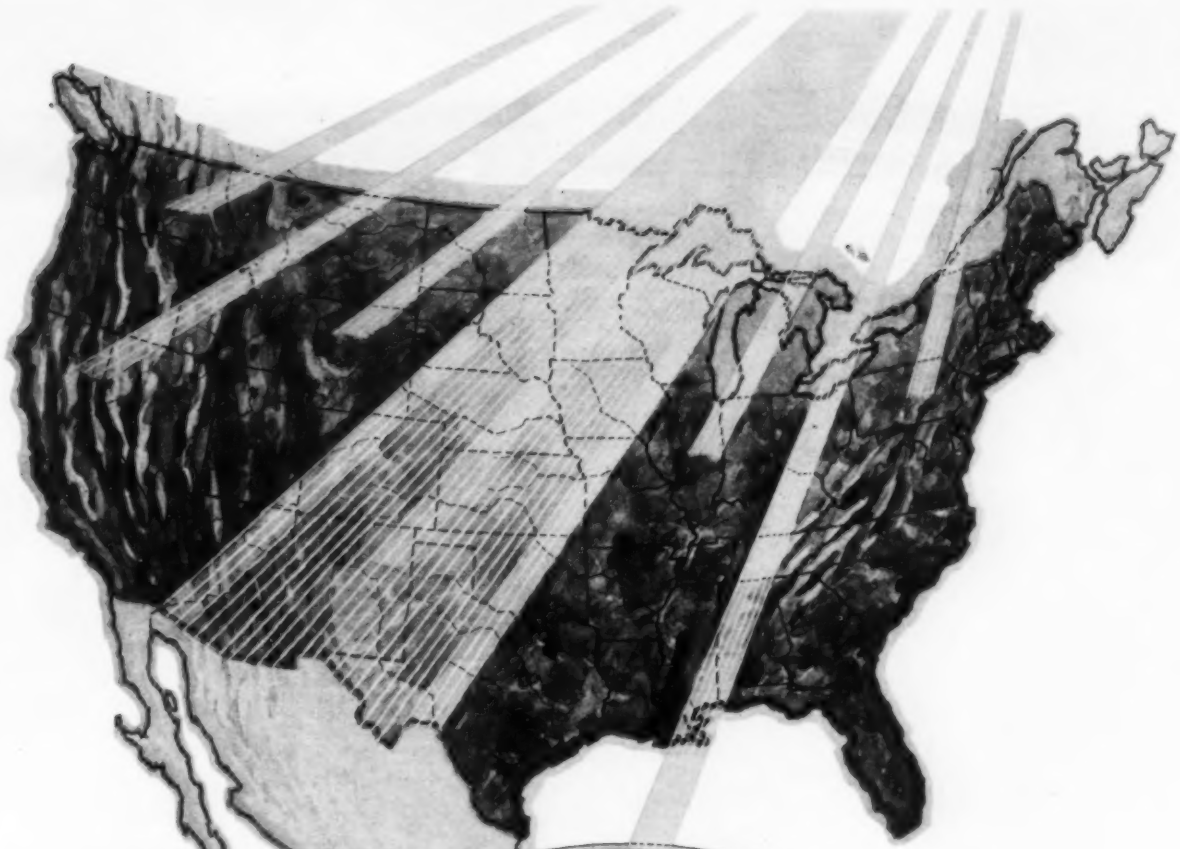
ATLAS

EXPLOSIVES

CHEMICALS ATLAS EXPLOSIVES



GOD'S COUNTRY

"Breathes there a man, with soul so dead,
Who never to himself hath said,
This is my own, my native land?"

—SCOTT

SURE we've taken it on the chin! Sure we've had our duststorms, droughts and depressions! *So what?* The gilt frame may have been broken, but the picture remains *unchanged.*

• • •

If you ever feel your knees getting a little shaky, try this simple experiment . . . repeat these words . . . *slowly*:

"Before the world, I AM AN AMERICAN! I envy no man. I fear no man. No man has anything I covet. No man can take away from me anything I have.

"Mine is a nation of *youth,* made out of a new kind of steel, alloyed with the blood strains of many peoples . . . not too stubborn to bend, but too strong ever to be broken.

"With its far-flung frontiers, mine is a land so broad, so rich in its hidden treasure, so vast in its resources that, if we had to, we could build a fence around ourselves and live forever . . . *alone.*

"Mine is a people of common stature, uncursed by class . . . vaccinated against all isms, cults and imported crack-pot philosophies . . . noisy at a ball game, but dangerously silent in battle.

"My people *think?* Over the roar of wheels, in thundering subways, in factory and field, in the depths of mines, amid the clank of tin dinner buckets, behind the drawn blinds of their thirty million homes, wherever they are, even now they are thinking . . . thinking out the answers that others cannot find. And, when the time comes, they speak . . . without stuttering.

"I am proud of American inventive genius; if there had never been *but just these few* Americans . . . Franklin, Fulton, Bell, Edison and the Wright Brothers . . . this would *still* be the greatest nation on earth.

"But most of all I give thanks for American Industry and for American business brains that have found a way to pay better wages . . . to work shorter hours . . . to pay more for their raw stuff . . . and still, with the help of mass production and mass distribution, give the people what they want *at prices they can pay.*"

• • •

So long as machinery continues to ease the strain on muscle, and Americans after a day's work aren't too tired to *play* . . . nothing really serious is going to happen to . . . GOD'S COUNTRY.

Published in the belief that there is more to Business than just selling goods—

LINK-BELT COMPANY

Equipment for
Handling Materials and Transmitting Power

Speed-o-matic Shovels Cranes Draglines

CHICAGO: 300 West Pershing Road
Distributors and Offices in Principal Cities

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MORE "RPM" DIESEL ENGINE LUBRICATING OIL IS BEING SOLD AND USED IN "CATERPILLAR" DIESEL ENGINES THAN ALL OTHER DIESEL OILS COMBINED!

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REGISTERED TRADEMARK

DIESEL ENGINE LUBRICATING OIL

Approved by

CATERPILLAR TRACTOR CO

STANDARD OIL COMPANY OF CALIFORNIA

NKS TO YOU COUNTY ENGINEERS

...And contractors who have demanded a LeTourneau Carryall Scraper in a smaller size . . . cheaper in price . . . incorporating all the job-proved features and rugged construction that have made them the standard the world over. The results have exceeded all expectations . . . here it is . . . the Scraper that fits the purse and purpose, the

G-6 CARRYALL SCRAPER

● The G-6 will do everything the larger LeTourneau Carryalls will do . . . is cable controlled . . . with *double* cable action: one operating the apron to a high lift position, the other the bowl. This action allows positive load control in all kinds of materials . . . and furnishes *independent positive ejection* . . . the bowl is self-cleaning . . . will spread its load in measured, accurate layers from 1" to 14". As with all Carryalls, the G-6 will draw in its own slope . . . will cut a ditch or back slope. A new standard of economy, too, is established; the "Caterpillar" D6 is the running mate for this 6-Yard Scraper, yet the G-6 is rugged enough to stay right with larger tractors. See it at the Road Show . . . or see your "Caterpillar" dealer for further details.

R. G. LE TOURNEAU, INC.

STOCKTON, CALIFORNIA **PEORIA, ILLINO**

***Cable Address:* "Bobletorno"**

***Manufacturers of:* ANGLEDOZERS*, BUGGIES*, BULLDOZERS, CARR ALL* SCRAPERS, CRANES, DRAG SCRAPERS, POWER CONTROL UNI ROOTERS*, TREEDOZERS.**

** Name registered U. S. Patent Offi*

LE TOURNEAU

32 TO 1 IN FAVOR

A "Caterpillar" Diesel D8 Tractor — owned by Guthrie-Marsch-Peterson Co.— ready to walk away with two Athey Wagons — 26 yards (loose measurement) per trip. This is at Irvin, Pa., where loading was going on at six separate shovel-units. 32 "Caterpillar" track-type Tractors on the job. Quick spotting under the shovel helped move the millions of yardage at a fast pace. On this operation, 4 "Caterpillar" Diesel Engines powered cranes and shovels!

Another of the 32 "Caterpillar" track-type Tractors at Irvin. Pulling a Le Tourneau Rooter (one of two rooters on the job), it is steadily, speedily tearing up rock and earth which is loaded into wagons by the 3 "Caterpillar" Elevating Graders.

OF "CATERPILLAR" TRACK-TYPE TRACTORS!

A NEW 65-million-dollar stripmill is being built at Irvin, Pennsylvania. Before work started, ground had to be cleared . . . timber salvaged . . . a high-tension line moved . . . floodlights erected . . . *and more than 3 million yards of material moved in 100 days!*

It was a mammoth task. And it developed into a great tribute to "Caterpillar" track-type Tractors and "Caterpillar" Diesel equipment. Thirty-three tractors were put on the job. *And 32 of those 33 were "Caterpillar" track-type Tractors!*

The record of work accomplished shows that the contractors knew what they were about, when they decided to lean so heavily on "Caterpillar" equipment. For the only major interruption (which lasted just a few days) came after a two-week rain resulting in a flood at Pittsburgh! Other than that, the "Caterpillar"-built Tractors kept on the job, day after day—24 hours every day—regardless of weather and conditions underfoot!

You've heard and read about the power, traction and dependability of "Caterpillar" track-type Tractors. This job—*but one of many big ones they've helped lick*—gives you positive proof of their performance! It also shows how highly other "Caterpillar" equipment is regarded. For the 32 tractors weren't the only "Caterpillar" units in action. Altogether, there were 40! . . . 3 elevating graders, 1 "Caterpillar" Diesel Auto Patrol, and 4 "Caterpillar" Diesel Engines, in addition to the tractors!

Whenever you have a tough job to crack, remember what was done at Irvin . . . *and count on "Caterpillar" equipment to take the work in its stride!*

● **AT THE 1938 NATIONAL ROAD SHOW,** the Caterpillar Tractor Co. and Allied Equipment Manufacturers will have all of the main floor of the Cleveland Auditorium. 45 pieces of the latest, most modern road-building machinery on display—*and in action.* (Almost a quarter-million dollars' worth of equipment!) Something doing all the time, on the main floor. *Make it your headquarters.*

⬆ "Caterpillar" Diesel Auto Patrol—another of the 40 "Caterpillar" units on the project—maintaining construction roads at a low fuel-cost.

⬆ Dumping and spreading at Irvin. Athey Wagons, hauled in tandem by a "Caterpillar" Diesel Tractor. Note the tractor at the left. Equipped with a La Plant-Choate Bulldozer, it levels off the fill as the wagons and other "Caterpillar" Diesel Tractor move away. 24 hours a day of this!

⬅ A "Caterpillar" Diesel Tractor pulls two Le Tourneau Carryall Scrapers in tandem. They're picking up rock and earth torn loose by the tractors and rooters.

CATERPILLAR

REG. U.S. PAT. OFF.

TRACTOR CO., PEORIA, ILL.

DIESEL ENGINES • TRACK-TYPE TRACTORS • ROAD MACHINERY

LAPLANT-CHOATE *Hydraulic Scrapers*

Have PROVED Their Superiority!

15 FULL YARDS with an RD-8!

Four years ago last month, LaPlant-Choate Manufacturing Company began to design and experiment with carrying scrapers. Their officials determined not to offer a single one for sale until this scraper had definitely and conclusively proved itself superior to any scraper on the market. And here is the scraper which has proved its superiority —

Superior because it will load and haul more and bigger loads per day with the same power. This superiority was attained by LaPlant-Choate engineers because conventional designs of other scrapers were abandoned and new original features were embodied. These unique features meet today's earth-moving needs in a manner unequalled by any other scraper on the market.

1 Narrower cutting bit reduces draft in loading and permits loading in tougher materials.

2 Cutting edge is serrated which again reduces cutting resistance.

3 Hydraulic down pressure on cutting edge forces blade to dig in hard ground.

4 The sides of the bowl are flared out and up from the cutting edge. This starts a lifting action as material enters the bowl like the hold board of a plow instead of compressing the load against the sides of a straight bowl and bulging the load upward.

5 The bottom of the pan does not hinge at a fixed high point at the rear. Instead, the entire bottom lowers evenly, keeping the back on the same level as the cutting edge. This eliminates loading up a steep incline on the scraper bottom and enables this scraper to fill the back of the bowl first with ease precisely as it should be done.

6 This scraper has a lower center of gravity which prevents tipping.

7 Hydraulic power not only pushes the load out but also pulls the push-out gate back to position for reloading.

8 Hydraulic power greatly reduces delays and upkeep cost due to cable breakages, etc.

9 Hydraulic power lifts or forces the front apron down.

See this scraper at the Road Show and learn all about its many superior features.

●

If you do not attend the Road Show, ask your "Caterpillar" and LaPlant-Choate Dealer for full information, or write direct to LaPlant-Choate Manufacturing Company, Cedar Rapids, Iowa.

(See announcement of smaller size scraper on opposite page.)

LaPLANT-CHOATE'S BID!

PAN LOWERED AND FRONT APRON RAISED FOR LOADING.

WITH A SMOOTH, EVEN CUT, THE BOWL IS EASILY LOADED. HYDRAULIC POWER BREAKS THE BITE, RAISES THE BOWL, AND THE FRONT APRON AUTOMATICALLY CLOSES TO HOLD THE LOAD.

THE HYDRAULIC JACK RAISES THE BOWL TO DUMPING POSITION WHERE LOAD WILL DROP OUT. THE SPREADER AT THE REAR THEN SPREADS THE LOAD AT DESIRED HEIGHT.

This company is prepared to supply two different types of scrapers to meet the need for better and more efficient self-loading and carrying scrapers.

For jobs which require the larger tractors and scrapers, we offer a superior push-out type large 15-yard scraper as described on the opposite page.

In that large field where smaller tractors and scrapers are best adopted, we offer the most efficient end-dumping scraper ever offered by any company.

This scraper embodies many of the advantages found in the large scraper such as narrow cutting bit to reduce resistance in loading — flared sides on the bowl to start material lifting up instead of compressing material against side of bowl — down pressure on the cutting edge to force it to dig in hard materials — serrated cutting edge to reduce resistance in cutting — back of bottom pan drops lower in loading to eliminate steep incline from cutting edge to back of bowl as heretofore used on other makes of scrapers. (This feature permits scraper to fill back portion of bowl first.)

In addition to the above, this scraper embodies many other new and novel features which increase its operating efficiency such as the automatic rear spreading device and automatic front apron, unusual simplicity with only one hydraulic jack to control all operations.

This scraper at present is available in the 5-6 yard size for use with "Caterpillar" D-6 Tractor. Other sizes will be released soon. See opposite page for description of large size scrapers.

See these scrapers at the Road Show or ask your "Caterpillar" and LaPlant-Choate Dealer.

ROADBUILDERS
SNOW PLOWS
TAMPING ROLLERS

LA PLANT-CHOATE MANUFACTURING CO. Inc.

CEDAR RAPIDS, IOWA.

BULLDOZERS
BRUSH CUTTERS
RUBBER WHEEL WAGONS

KILLEFER WILL BE AT THE ROAD SHOW

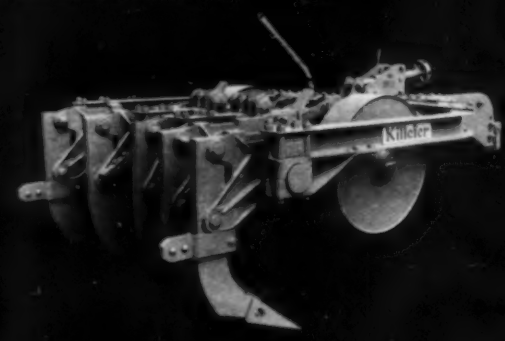
see *ask*

January 17-21 — Cleveland, Ohio

about KILLEFER ROAD EQUIPMENT

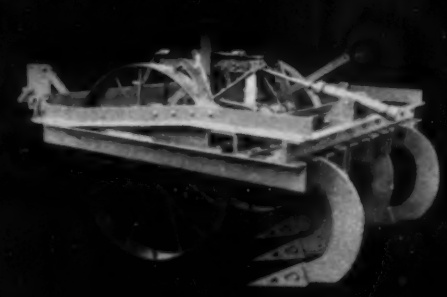
Road Disks, or Planers

Revolving Rippers



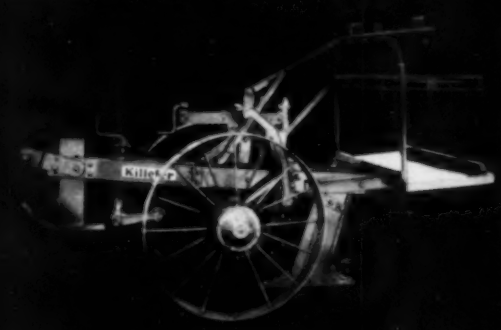
Revolving Scrapers

Regular Rippers



Compacting Harrows

No. 201 Wire-Layer

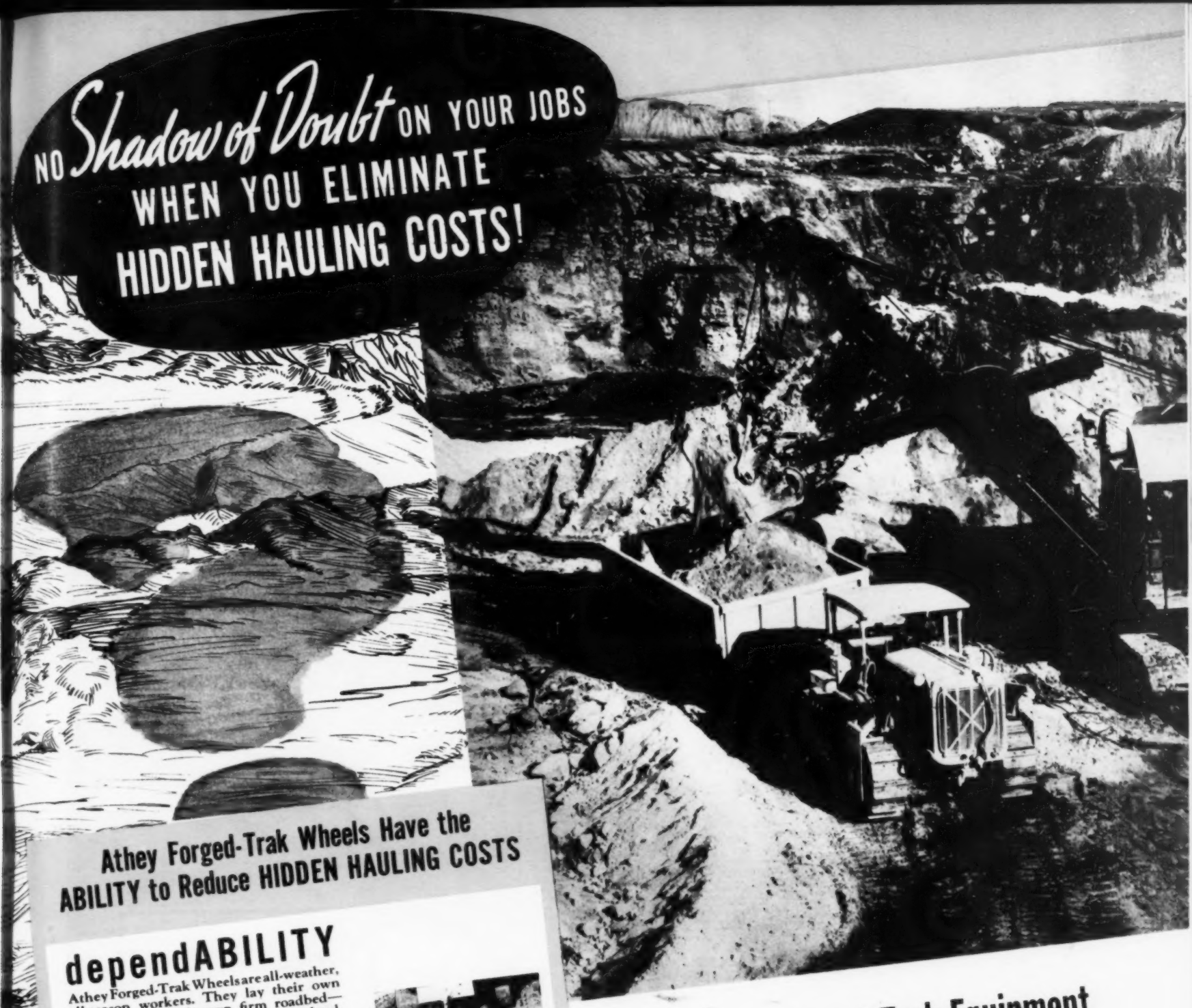


These units will be displayed at Cleveland

KILLEFER MANUFACTURING CORPORATION

Branch: Peoria, Illinois — Los Angeles, California

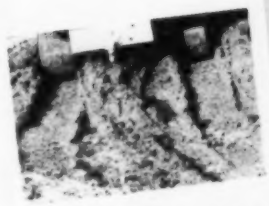
NO *Shadow of Doubt* ON YOUR JOBS WHEN YOU ELIMINATE HIDDEN HAULING COSTS!



Athey Forged-Trak Wheels Have the ABILITY to Reduce HIDDEN HAULING COSTS

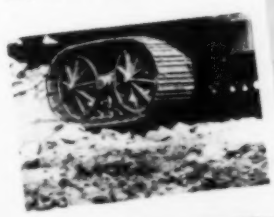
dependABILITY

Athey Forged-Trak Wheels are all-weather, all-season workers. They lay their own steel rails on their own firm roadbed—are *dependable* in maintaining your hauling schedules when ordinary equipment is tied up. Athey Wheels eliminate the costly weather hazard from your hauling operations.



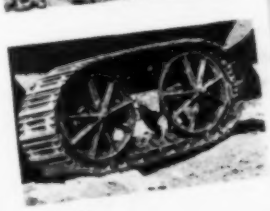
adaptABILITY

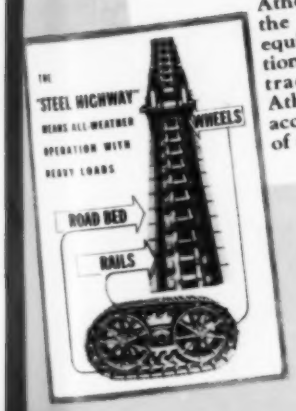
Knife-edged stones, grinding gravel, deep mud, ice chunks, uneven roadbeds—these roading hazards have little effect upon the "steel highway" under the Athey Wheel. *Adaptable* to all conditions, they eliminate much of the extra costs of road maintenance.



durABILITY

Built to meet the conditions that have to be met on *your* jobs, Athey Forged-Trak Wheels are the kind of *durable* hauling equipment that cuts depreciation allowances on your contracting bids. Furthermore, Athey Wheels have the most accurately predeterminable life of any load-carrying wheel.





With Athey Forged-Trak Equipment

You don't want to *wonder* how much your hauling is going to cost you when you bid for a job. You want to *know*. And you will know if you put Athey Forged-Trak Wagons and Trailers to work for you, because Athey equipment has the ability to eliminate those HIDDEN HAULING COSTS that put the question marks in your cost sheets.

ATHEY TRUSS WHEEL CO.
5631 West 65th Street Chicago, Illinois

Cable Address: "TRUSSWHEEL" Chicago

ATHEY Forged-Trak
Reg. Trade-Mark

2-WAY DUMP TRAILERS

A DEPENDABLE SERVICE

goes with this
Dependable Product

WHEN you order USS Concrete Reinforcing Bars you can count on prompt delivery of a product that is of top quality. The facilities of our distributors are conveniently located to give you quick service, and full stocks of standard sizes and lengths are carried to meet your immediate needs.

All USS Concrete Reinforcing Bars carry the Quality Mark of the Concrete Reinforcing Steel Institute. This symbol on Concrete Reinforcing Bars is your assurance that the bars meet the highest standards in the industry. They are rolled from new billet steel, and are a product of domestic manufacture.

Our service is complete. We are equipped to cut and bend USS Concrete Reinforcing Bars to your specifications wherever facilities may be inadequate. Specify USS Concrete Reinforcing Bars and avoid costly delays caused by slow and incomplete delivery of materials.

Be sure that the Quality Symbol of the Concrete Reinforcing Steel Institute is on all Concrete Reinforcing Bars you buy.

U·S·S CONCRETE REINFORCING BARS

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CARNEGIE-ILLINOIS STEEL CORPORATION · *Pittsburgh and Chicago*
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TENNESSEE COAL, IRON & RAILROAD COMPANY · *Birmingham, Ala.*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Expert Distributors*

UNITED STATES STEEL

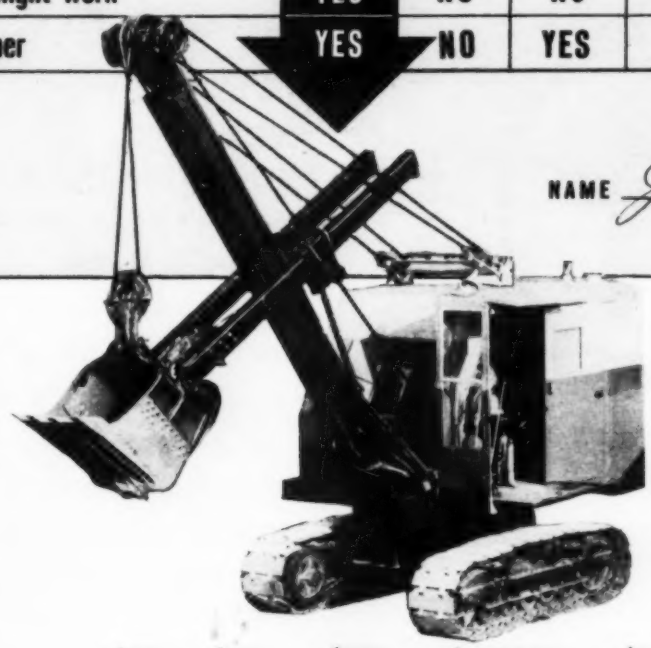
BUY *By Comparison* AND YOU WILL BE SURE TO BUY

A MARION.....

COMPARISON CHART

	FEATURES	MARION	A	B	C	D	E	
1	Self-cleaning, non-clogging crawlers	YES	NO	NO	NO	NO	NO	
2	Manganese steel crawler belts	YES	NO	NO	NO	NO	NO	
3	Extremely light weight and flimsy construction	NO	YES	YES	NO	YES	YES	
4	Adequate power to handle heavy digging	YES	NO	YES	NO	NO	NO	
5	Simple and accessible machinery deck arrangement	YES	NO	NO	NO	NO	NO	
6	Silent chain power take-off—not gears	YES	NO	YES	NO	YES	YES	
7	Trouble-free cone rotating clutches	YES	NO	NO	NO	NO	NO	
8	Splined shafts at important points	YES	NO	NO	YES	NO	NO	
9	Positive Chain crowd	YES	YES	NO	NO	YES	NO	
10	Tapered Hoisting Drum	YES	NO	NO	NO	NO	YES	
11	Standard lighting equipment for night work	YES	NO	NO	YES	NO	NO	
12	Full measure two-piece cast dipper	YES	NO	YES	NO	NO	NO	

NAME *Jamieson Pullman*



Check Marion against every other excavator . . . point for point. You'll discover in Marion ALL the advantages of competitive machines PLUS many other design and construction features exclusive to Marion . . . features originated and developed by Marion engineers. Marion invites comparison . . . for if you buy by comparison, you're bound to buy Marion. There is a Marion for every material handling job. » »

"When the question of a small shovel came up, we talked to several owners of shovels . . . compared their production records and maintenance costs . . . and bought a Marion," says Geo. L. Potts, Pres., Potts & Callahan Contracting Co., Inc., Baltimore, Md.

See us at the Road Show, Cleveland, January 17-21 inclusive—Booth A-22. . .

The MARION STEAM SHOVEL CO., MARION, OHIO - U.S.A.

TEXACO

swings into

1938

TEXACO

During the past third of a century, thousands of miles of America's streets and highways have been paved with TEXACO Asphalt.

TEXACO-paved roads and streets include Sheet Asphalt, Asphaltic Concrete, Asphalt Macadam and the Low Cost Road-Mix and Plant-Mix types. They extend into every State east of the Rockies and serve more than 1,500 cities and towns.

With the asphalt refining skill and facilities built up during that third of a century, TEXACO now swings into 1938.

THE TEXAS COMPANY, Asphalt Sales Department, 135 East 42nd Street, New York City

Chicago Cleveland Kansas City Houston Dallas Buffalo Philadelphia Richmond Boston Jacksonville

TEXACO ASPHALT

● *"Unit 6½" shovel with Nickel-chromium-steel (SAE 3140) gears, and (SAE 3240) shafting, manufactured by Universal Power Shovel Corporation, Milwaukee, Wisconsin.*

...less wasted in moving dead weight

BUILD rugged strength into heavy duty equipment. At the same time, reduce useless weight—both accomplished when you employ the Nickel alloy steels. These two examples show how it is done in the case of two leading manufacturers of construction equipment:

1. Universal Power Shovel Corporation of Milwaukee, who use Nickel-chromium steels for the "Unit" shovel shown above, report as follows:

"We use Nickel alloy steels extensively throughout our machine because they provide uniformly high properties and are easy to heat treat without serious distortion. They are tough and dependable and have a high fatigue limit. This last feature is especially important in many of the shafts in power shovels, since they are constantly subjected to reversing loads."

2. When the Gar Wood hydraulic road scraper illustrated was re-designed, "Yoloy" Nickel-copper-steel was adopted. Result: weight reduced 5,000 lbs.—or an equivalent increase in payload of 20%.

● *Hydraulic road scraper manufactured by Gar Wood Industries, Inc., Detroit, Michigan. By using "Yoloy" Nickel-copper-steel produced by the Youngstown Sheet and Tube Co., Youngstown, Ohio, weight was cut from 18,500 to 13,500 lbs.*

Where toughness and dependability are essential, and where breakage or failure of vital parts would cause expensive operating delays, employ the Nickel alloy steels. Consultation on their use is invited.

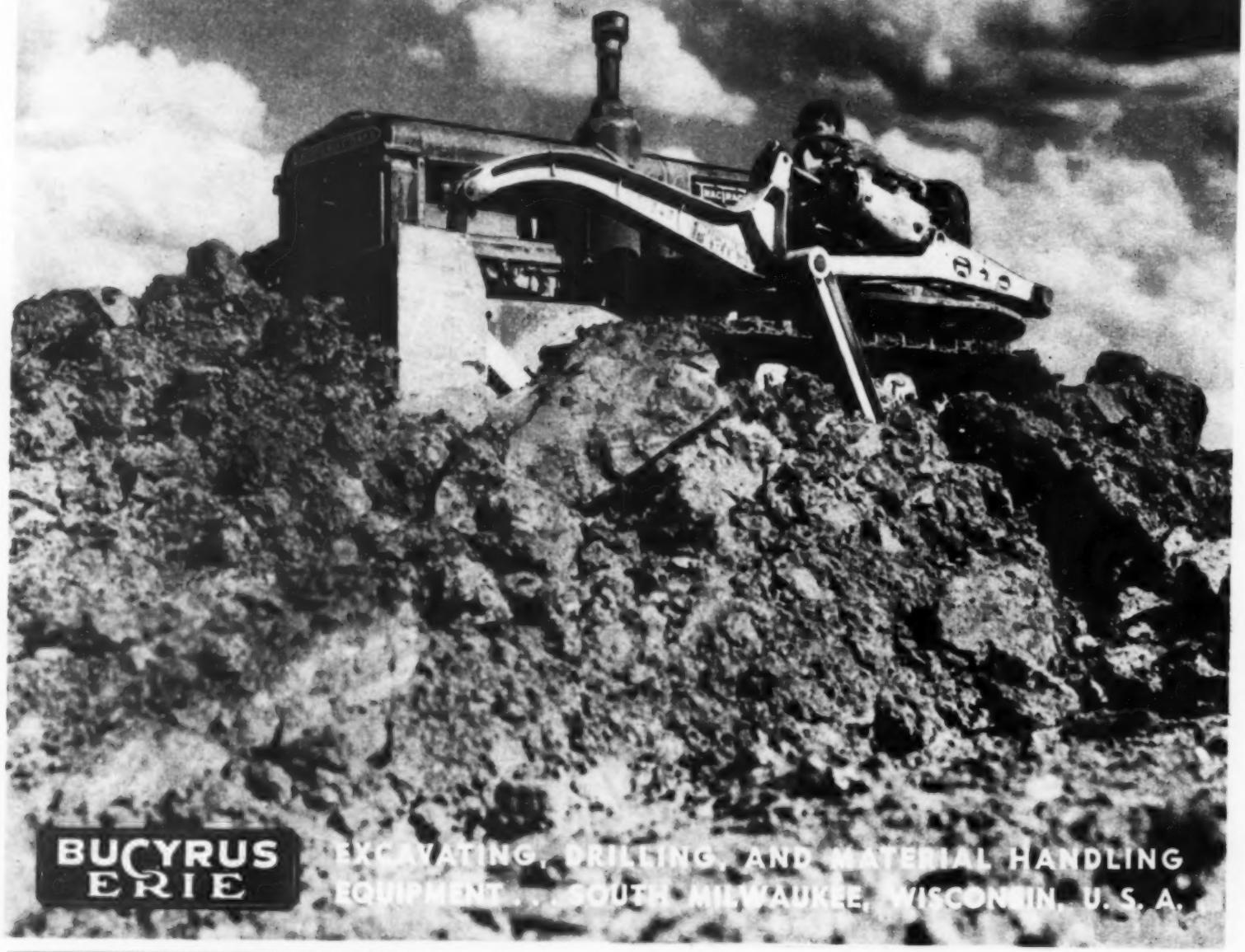
NICKEL ALLOY STEELS

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

BUCYRUS-ERIE

BIG *pay loads*

FAST blade travel and positive, hydraulic control increases the work range of the Bucyrus-Erie Bullgrader and Bulldozer, while balanced design makes full tractor power available to move big pay loads on every job. The blade is built to move the biggest loads possible with the tractor power available; it is correctly curved to roll the dirt freely and thus cut down resistance; it is made to withstand shock-loads; it is the "business end" of a powerful, modern dirt-moving unit that has set new standards for performance and economy. Investigate the Bucyrus-Erie Bullgrader and Bulldozer.



BUCYRUS ERIE

EXCAVATING, DRILLING, AND MATERIAL HANDLING EQUIPMENT . . . SOUTH MILWAUKEE, WISCONSIN, U. S. A.

Construction Methods and Equipment

Established 1919 McGraw-Hill Publishing Company, Inc.

ROBERT K. TOMLIN, Editor

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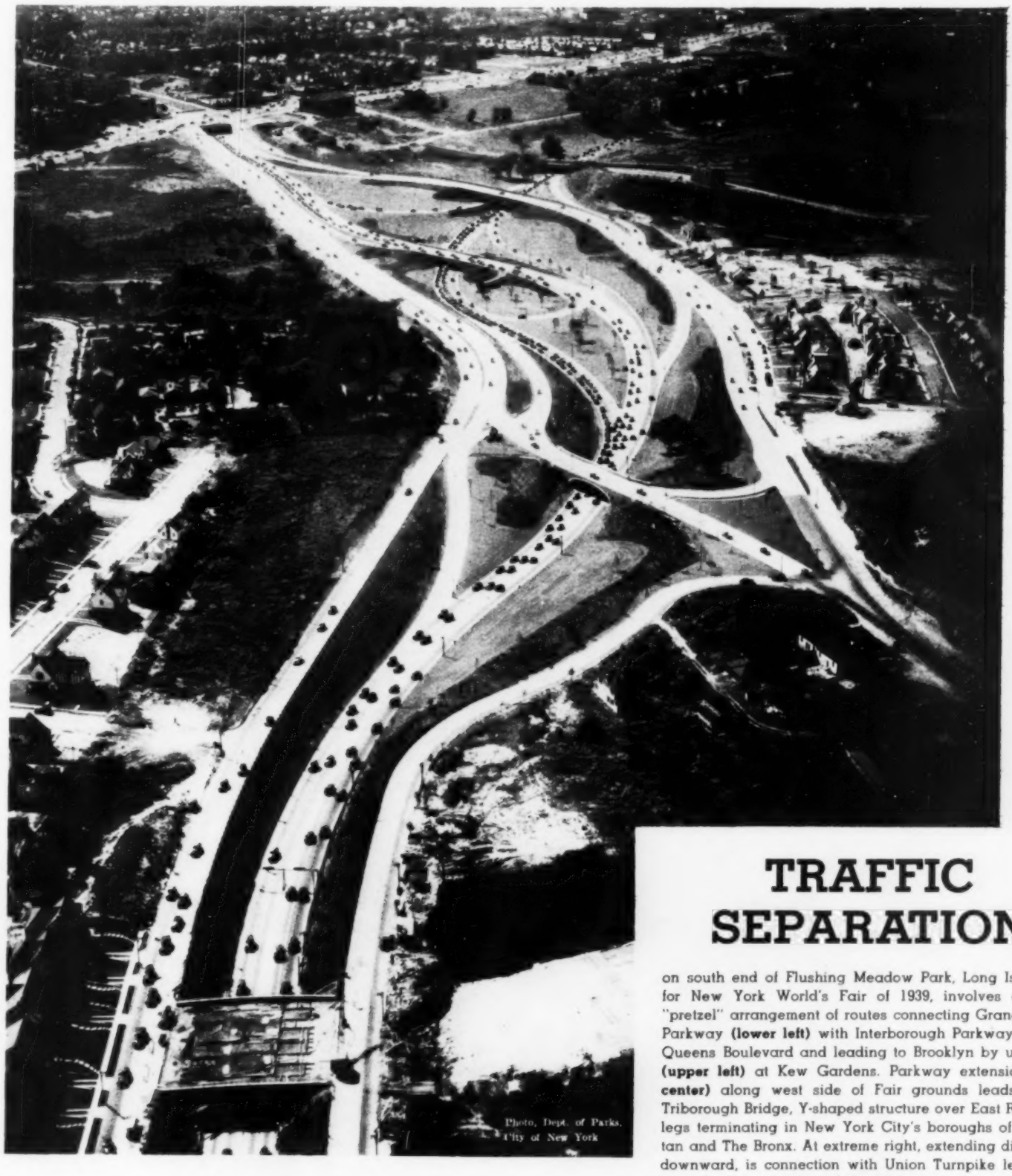


Photo, Dept. of Parks, City of New York

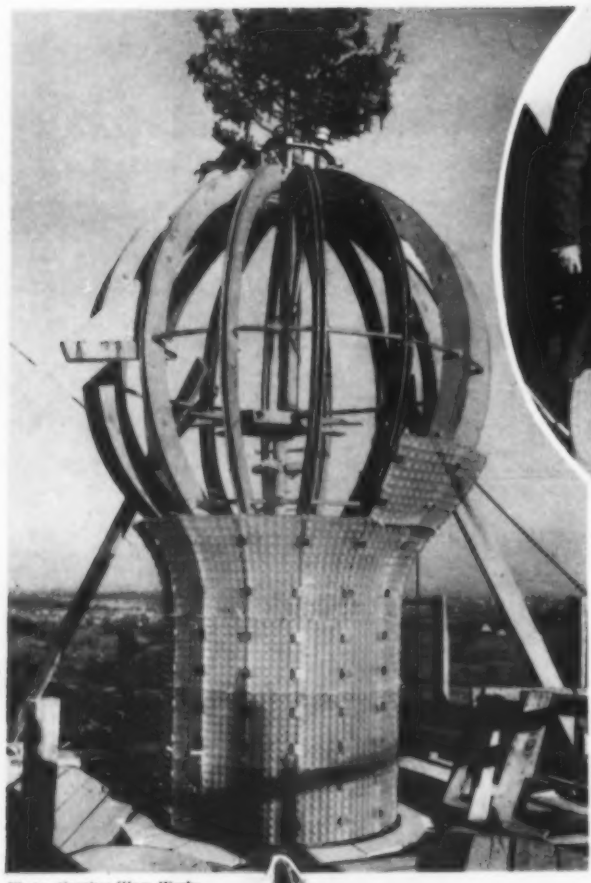
TRAFFIC SEPARATION

on south end of Flushing Meadow Park, Long Island site for New York World's Fair of 1939, involves elaborate "pretzel" arrangement of routes connecting Grand Central Parkway **(lower left)** with Interborough Parkway crossing Queens Boulevard and leading to Brooklyn by underpass **(upper left)** at Kew Gardens. Parkway extension **(right, center)** along west side of Fair grounds leads to new Triborough Bridge, Y-shaped structure over East River with legs terminating in New York City's boroughs of Manhattan and The Bronx. At extreme right, extending diagonally downward, is connection with Union Turnpike leading in easterly direction through Jamaica and other Long Island communities.

This Month's

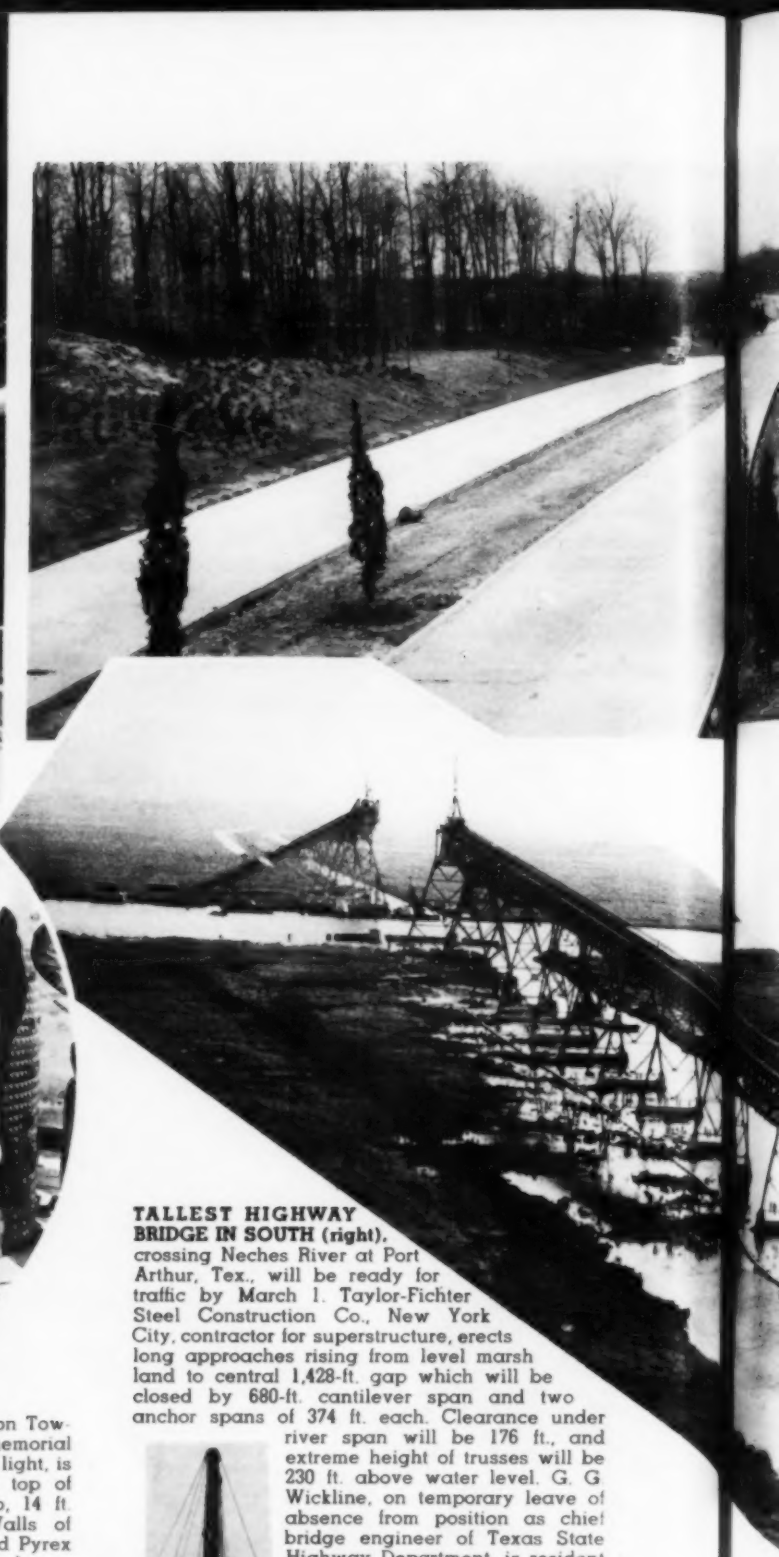
"NEWS REEL"

SODIUM LIGHTS provide effective illumination for six-lane roadway carried by 4,200-ft. suspension span of San Francisco's Golden Gate bridge. A total of 199 General Electric luminaires, producing non-glare golden glow, are spaced opposite to each other and at an average distance of 150 ft. apart.



Photo, Corning Glass Works

TOPPING OUT (left) of 131-ft. Edison Tower, erected at Menlo Park, N. J., as memorial to famous inventor of incandescent light, is celebrated by setting fir tree on top of steel frame for giant electric bulb, 14 ft. high, which crowns structure. Walls of bulb are formed of 153 amber-tinted Pyrex glass sections 2 in. thick. Reinforced concrete shaft of structure was erected by Walter Kidde Constructors, Inc., of New York City, under supervision of William Collins **(at left), above)** vice-president. Also present at ceremony were W. S. Barstow, **(center)** president of Thomas Alva Edison Foundation, donor of $100,000 tower, and Alfred V. Du Pont, architect.



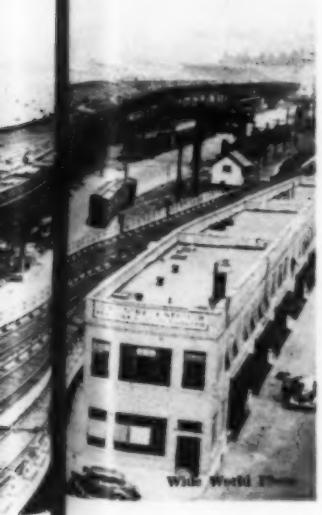
TALLEST HIGHWAY BRIDGE IN SOUTH (right), crossing Neches River at Port Arthur, Tex., will be ready for traffic by March 1. Taylor-Fichter Steel Construction Co., New York City, contractor for superstructure, erects long approaches rising from level marsh land to central 1,428-ft. gap which will be closed by 680-ft. cantilever span and two anchor spans of 374 ft. each. Clearance under river span will be 176 ft., and extreme height of trusses will be 230 ft. above water level. G. G Wickline, on temporary leave of absence from position as chief bridge engineer of Texas State Highway Department, is resident engineer in charge of project.

HIGHWAY WIDENING (right) to provide traffic safety converts single 22-ft. roadway of Dalton Ave., Pittsfield, Mass., into two 22-ft. concrete-paved thoroughfares separated by 20-ft. wide grass-covered separating strip. Each roadway of 8-in. thick concrete pavement, built by Lane Construction Corp., of Meriden, Conn., is bordered by 8-ft. macadam strips.

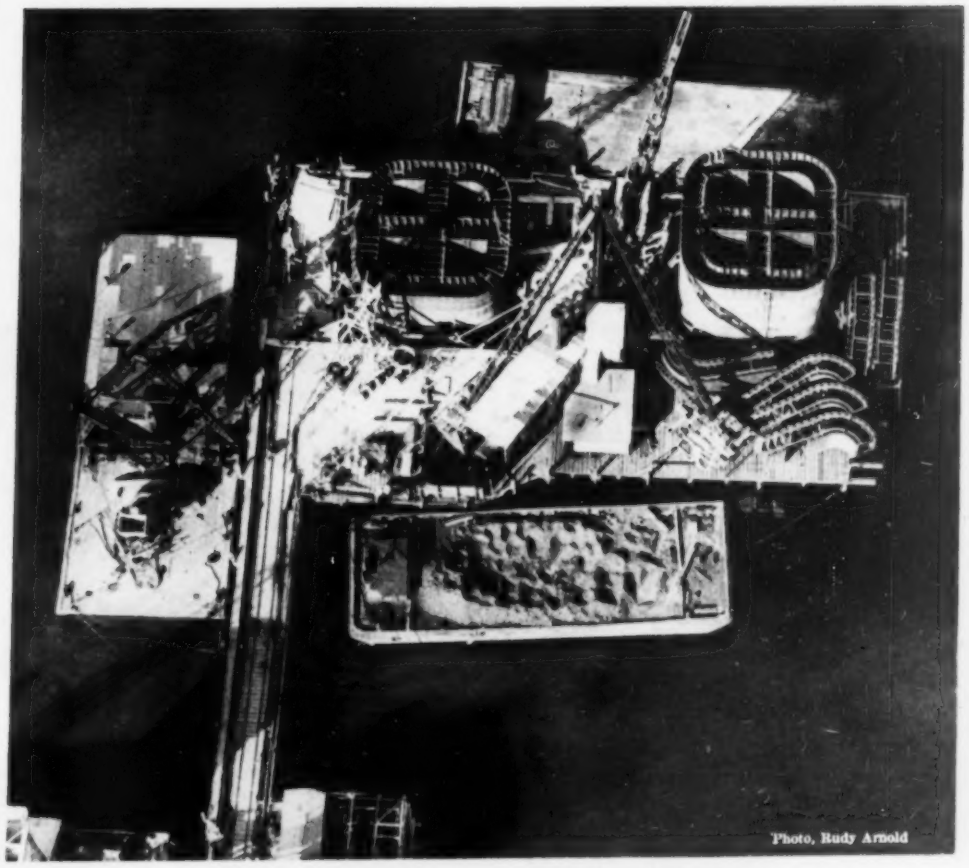
CONNECTICUT'S MERRITT PARKWAY puts two 27-ft. 4-in. concrete roadways, separated by 21-ft. central strip, **(left)** on right-of-way 300-ft. wide. Connecting at state line with Westchester County (N.Y.) Hutchinson River Parkway, new Connecticut boulevard runs 38 mi. eastward to junction with Boston Post Road between Bridgeport and New Haven. Parkway separates grades by bridges at almost 70 intersections and eliminates access drives to abutting property. In paving one section of total of about 15 mi. completed by various contractors during last 6 months, New Haven Road Construction Co. uses first Rex 34E dual-drum paver **(below)** ever put in field. New design of large-capacity mixer involves radical change from standard Rex 27E single-drum paver.

Photo, Rudy Arnold

CLOVERLEAF separates traffic at intersection of 79th St. with newly opened West Side Improvement along Hudson River, New York City, completed under direction of Robert Moses, Commissioner, Department of Parks, City of New York. Grade crossing elimination structure combines new traffic routes with depressed fountain and masonry closters housing riverside restaurant. Parkway from 72nd to Dyckman Sts. has two 34-ft. separated roadways, paved with concrete.



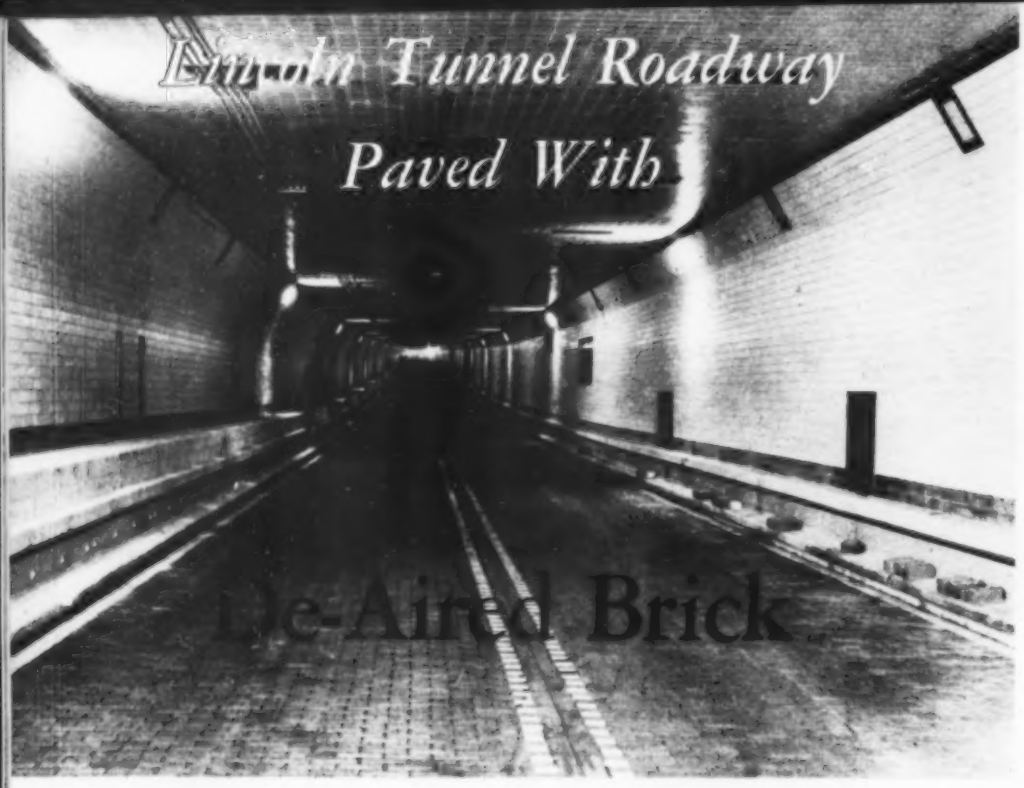
FINAL LINK (left) of West Side elevated highway along Hudson River, New York City, nears completion in vicinity of 135th St., providing non-stop major traffic artery between Canal St. and George Washington bridge. Contractor for substructure on this section of project costing $1,292,600 was P. T. Cox Contracting Co., of New York City, and for superstructure, involving 8,500 tons of structural steel, George F. Bristoll Co., of Brooklyn, N. Y.



Photo, Rudy Arnold

CAISSON FOUNDATIONS for piers of Bronx-Whitestone bridge spanning East River, New York City, take form under contract for $1,894,000 awarded to Frederick Snare Corp. Structure will include 2,300-ft. central suspension span and 735-ft. side spans, carrying four-lane roadway. Piers will support cellular steel towers 380 ft. in height. Bridge is being built under supervision of Triborough Bridge Authority, of which O. H. Ammann is chief engineer.

Lincoln Tunnel Roadway Paved With De-Aired Brick



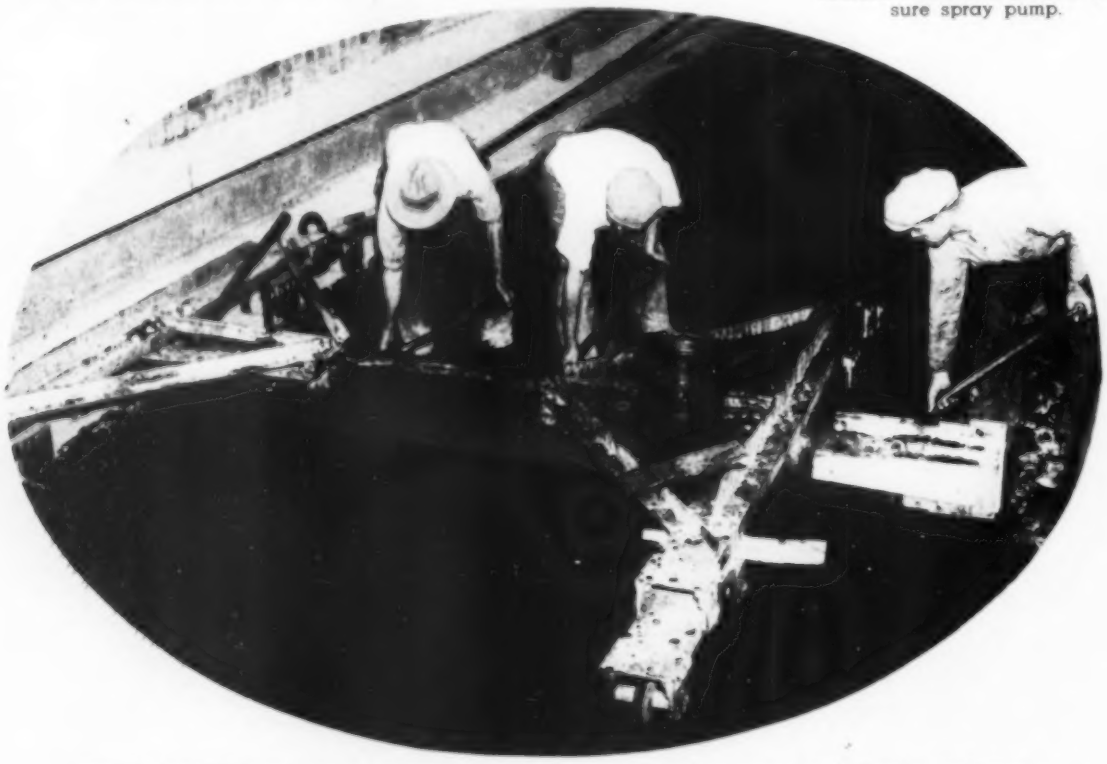
TUNNEL INTERIOR (left) approaches completion in preparation for opening to traffic on Dec. 22. Glass tile on ceiling and on walls improves illumination by its reflecting power even during construction period, when only every fourth light is burning, to save electricity. Temporary power cables for construction service still are in place, suspended from exhaust air vents in ceiling, and some cleaning up remains to be done inside long tunnel.

THEIR EXPECTATIONS with regard to brick paving confirmed by short-test sections laid in the New Jersey plaza and exit ramp of the Holland Tunnel, Port of New York Authority engineers specified a similar wearing course for the south tube of the Lincoln tunnel, crossing the Hudson River between midtown Manhattan and Weehawken, N. J. A contract for 26,100 sq.yd. of brick pavement extending a total distance of more than 1¾ mi. through the tunnel and beyond the portals, was awarded to W. J. Fitzgerald, New York City, about Sept. 15. Paving operations started Sept. 23, and the work was completed by Dec. 1, in ample time for opening the tunnel to traffic on Dec. 22. Specifications for the work, published in April, 1937, contained several innovations which only recently have become recognized as valuable contributions to brick paving technique.

Special Provisions—Prior to placing the sand-mastic cushion on the concrete base, for example, the specifications required that the contractor spray the base with a cutback asphalt of the same composition used in the cushion. After the brick had been placed on the cushion, the specifications further required that the surface be rolled longitudinally by a power operated tandem roller traveling on a floor of 1-in. wood boards dressed to uniform thickness. Application of cutback asphalt prime to the concrete base was intended to bind the sand mastic material to the concrete and prevent any shoving or creeping of the cushion. Use of the 1-in. dressed lumber under the power roller served to distribute the concentrated load of the front and rear wheels over a large area of brick surface and cushion, thus diminishing chipping and cracking of the brick and producing a smoother riding surface with fewer sharp irregularities.

As a separating agent, to prevent adherence of surplus asphalt joint filler to the upper surface of the brick, either a calcium chloride-starch solution or approved commercial agent was permitted. In applying the solution, the contractor was required to use a pressure spray pump or similar device so manipulated as to cause the material to settle vertically downward on the exposed surfaces in a fine mist or fog, enabling the operator to coat the upper exposed surfaces of the brick without penetrating into the joints.

PRIOR TO PLACING sand mastic cushion on concrete base workmen apply prime coat of asphalt cutback with hand-operated pressure spray pump.



STRIKEOFF TEMPLET, pulled by long wire-rope bridle attached to motor truck, levels sand mastic material to desired grade. Compensating dollies, supporting templet, ride at one side on concrete curb and at other side on concrete base. In latter case, thin steel disks are substituted for flat wheels to avoid excessive displacement of cushion material.

At the few points where cork expansion joints had been placed in the concrete base, the brick paving design called for similar joints in the wearing course, premolded strips of pre-compressed, dehydrated granular cork bound with an insoluble resin being placed in vertical position between brick courses as closely as possible above the joint in the base. The cork joint filler in the brick pavement rested on a 4-in.-wide strip of copper flashing laid in a mopping of asphalt cutback on top of the joint in the concrete base and primed simultaneously with the base with a coat of sprayed asphalt cutback. By its reversible self-expanding and compressible properties, the cork filler is relied upon to keep the joints watertight during movement of the brick pavement caused by expansion and

TWO BRICK DROPPERS lay successive courses from center line of roadway to concrete curb. White glazed vitrified markers are placed in alternate brick courses to form row parallel with and adjacent to center line of tunnel roadway.

contraction of the underlying concrete.

Extent of Work — Included in the contract was one continuous stretch of roadway paving 8,425 ft. long, extending from a point 108 ft. outside the New York portal to a point 100 ft. beyond the New Jersey portal. This roadway had a uniform width of brick paving inside the tunnel of 20 ft. between concrete headers 9 in. wide, giving a total roadway width of 21½ ft. In addition, the contract called for brick paving to the unusual width of 180 ft. between curbs for a length of about 285 ft. in the Weehawken Plaza, where toll booths are located to collect tolls both for the completed south tube and for the uncompleted north tube, at present being driven by compressed-air shield tunneling methods through the Hudson River silt from New Jersey to New York. The brick paving in the plaza includes all that between and adjacent to the toll booth islands, where the surface receives the hardest wear from the stopping and starting of vehicles. Beyond this section, brick paving

ON WOOD FLOOR of 1-in. dressed boards laid to form continuous platform over surface of brick, 5-ton roller performs slow-moving longitudinal rolling operation, bedding brick in sand mastic cushion with less damage than under former method of rolling on bare, unprotected surface.

was placed under the same contract on about 570 ft. of variable-width roadway on the west ramp, including about 300 ft. in an underpass under Park Ave., Weehawken.

Pavement Design—Designed with a maximum capacity of 750,000 vehicles a month, the tunnel is expected to carry about 500,000 vehicles a month during the period when it will furnish two-way service, pending completion of the second, or north, tube. For the roadway pavement the specifications called for vertical fiber, wire-cut lug brick, manufactured by the de-airing process, thoroughly vitrified and annealed, and possessed of a good non-skid surface. The brick was 3 in. deep, with surface dimensions 4x8½ in. Specifications prohibited variations greater than ⅛ in. in depth or width and greater than ¼ in. in length.

Particular effort was made in the pavement design to provide permanent and unmistakable traffic markers between the two lanes. Double lines of white glazed vitrified markers with 4x4-in. surface areas were laid adjacent to and parallel with the center line of the roadway, and electrically illuminated traffic markers were installed at 50-ft. intervals in the 8-in. spacing between these double lines. White marker units were set in every second brick course, as is shown in several of the accompanying photographs, and the intervening space between the two rows of white markers was filled by two courses of brick laid longitudinally.

Bricks were laid on a ¾-in. mastic cushion struck off to true grade by a truck-drawn templet equipped with a steel cutting edge, and the joints were filled with hot asphalt. Both after the rolling of the brick and again after the cleaning of surplus asphalt filler from the surface, the brick pavement was checked longitudinally with a 10-ft. straight-edge to eliminate inequalities exceeding 3/16 in. in 10 ft.

Test Sections—With the exception of the innovations mentioned in the first part of these notes, similar brick paving practice was followed in constructing the test sections at the New Jersey entrance of the Holland Tunnel. The Port of New York Authority laid the first of these test sections in February, 1935 — a small area of pavement 10 ft. wide and 45 ft. long leading to the treadle at one of the New Jersey toll booths. Later in the same year the Authority paved 500 ft. of fairly steep grade in both lanes of the New Jersey exit from the north tube. The service record of the test sections was highly satisfactory.

Working Schedule—In the Lincoln tunnel, one lane of the roadway had to be kept open at all times for use by other contractors, and the paving contractor was prohibited by specifications from stacking or storing materials on the tunnel sidewalk or terra cotta ledges. As a result of these requirements, the paving crew was severely hampered by lack of storage facilities but, in spite of the fact, managed to average about 800 sq.yd. of pavement per 8-hr. day. The paving crew consisted of 35 men and two foremen, acting under a superintendent; two of the men worked as droppers.

Paving work started inside the tunnel near the New York portal and worked west by alternate stages in the two lanes to the New Jersey

TRANSPARENT SEPARATING AGENT to prevent adherence of surplus asphalt joint filler to upper exposed surface of brick is applied as fine mist to pavement surface by workman operating portable pressure spray pump.

Contract Quantities and Prices
LINCOLN TUNNEL PAVING

Item	*Quantity*	*Unit Price*	*Amount*
Brick pavement, sq.yd.	26,100	$3.60	$93,960.00
White vitreous lane markers, each	25,100	0.35	8,785.00
Illuminated lane markers, each	185	170.00	31,450.00
Air measurement boxes, each	198	4.00	792.00
		Total	$134,987.00

COMPLETED PAVEMENT comprises 20 ft. of brick surface between flush header curbs 9 in. wide, giving total roadway surface of 21½ ft. Traffic lanes are clearly separated by double row of white glazed vitrified markers, with electrically illuminated markers set at intervals of 50 ft. between two rows.

portal and Wechawken plaza. While working in the tunnel, the crew moved out one day to the New York portal to lay the pavement at this entrance. Ordinarily the contractor laid about 1,500 ft. in one lane before moving over to the adjacent lane to catch up with the paving.

Paving Operations—A base prime coat sufficient to blacken the concrete surface was applied in advance of the sand-mastic cushion by a portable pressure spray pump in a wheelbarrow mounting. The contractor dried sand for the mastic cushion in the oil-fired dryer of an asphalt plant and delivered it to the bare concrete base ahead of the prime coat by end-dump trucks. Sand and asphalt were mixed in a portable Koehring concrete mixer in ½-cu.yd. batches having volume proportions of 4 per cent cutback asphalt and 96 per cent sand. Specifications called for proportions, by weight, of 7 to 4 per cent asphalt cutback and 93 to 96 per cent dry sand.

From the mixer the mixed material for the sand-mastic cushion was transported and placed on the primed base by wheelbarrows. A strikeoff, mounted on compensating dollies to reduce irregularities in the base and attached by a long hauling rope to a motor truck, was drawn forward to level the material to the proper grade. Wheels of the dollies supporting this device at the end near the center line of the roadway consisted of thin steel disks which caused little disturbance as they were drawn through the sand mastic cushion. At the other end, the dollies were supported by broad-tired, small-diameter steel wheels riding on the concrete curb, which had been finished to true grade. Two brick droppers worked behind the strikeoff, placing successive brick courses from the center line toward the curb, as required by specifications.

Sufficient 1x10-in. by 12-ft. dressed boards always were on hand to cover at least 50 lin.ft. of single-lane pavement. Before starting the rolling, workmen placed these boards in contact over the area to be rolled, staggering the transverse joints by 6 ft. For the rolling, the contractor used a 5-ton gasoline-driven Buffalo-Springfield tandem roller which worked longitudinally over the area, starting at one edge and shifting not more than 10 in. transversely on successive passes, as specified. The finished pavement was tested over its entire width with a 10-ft. straight-edge applied longitudinally, and deviations exceeding 3/16 in. in 10 ft. were corrected.

BATTERY OF KETTLES heats asphalt joint filler, which is transported to point of application in hand-pushed wheelbarrows.

To the surface of the rolled section, a hand-operated pressure spray pump applied calcium chloride solution made in the proportions of 35 per cent calcium chloride, 1 per cent laundry starch and 64 per cent water. The separating agent dried quickly and permitted the application of asphalt joint filler to follow within a few minutes. Asphalt heated to a temperature between 400 and 450 deg. F. was poured on to the brick from buckets and was allowed to penetrate into the joints without the aid of squeegees or lutes, which were prohibited by the specifications. The contractor operated a battery of seven kettles for heating asphalt, four Littleford Bros. kerosene-burning kettles of 150-gal. capacity, two new Aeroil 300-gal. kerosene-fired units and one old 500-gal. wood-burner. When the poured asphalt had reached a leathery condition, the surplus filler on the surface was stripped off with sidewalk cleaners, care being taken to avoid pulling or loosening the asphalt in the joints.

EXCESS JOINT FILLER peels readily from brick surface when lifted by sharp-edged sidewalk cleaners. In background stands W. L. Barr, technical advisor representing Metropolitan Paving Brick Co.

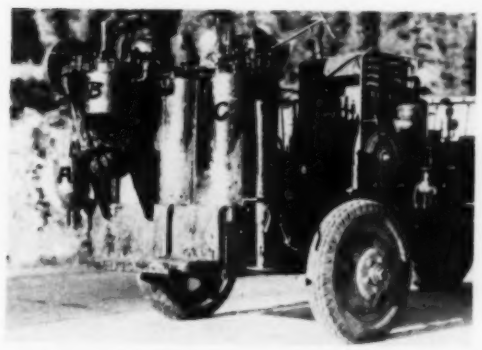
When the brick surface had been cleaned, the pavement was tested again for smoothness with the aid of 10-ft. straight-edges in a longitudinal direction, and any irregularities exceeding 3/16 in. in 10 ft. were corrected by adjusting the cushion and relaying the brick.

Administration—For the Port of New York Authority, O. H. Amman is director of engineering; J. C. Evans is chief engineer; and Charles S. Gleim is engineer of construction. The resident engineer for the tunnel, in direct charge of paving work, was Thomas Darrow.

Paving operations were directed for the contractor, W. J. Fitzgerald, New York City, by J. A. Williamson, superintendent. For the Metropolitan Paving Brick Co., Canton, Ohio, manufacturer of the brick, W. L. Barr served as resident technical advisor to the contractor.

Bitumen and Rubber Latex *Form Improved* Joint Filler

THOMAS E. STANTON, JR., materials and research engineer, California Division of Highways, demonstrates ductility of bitumen-rubber latex filler after year's service.



MIXING EQUIPMENT for preparing and heating bitumen-latex joint filler. From container A latex is fed slowly into mixing drum B, into which asphaltic oil is measured and then mixed with latex. Asphaltic oil is stored in tank C.

CONE-SHAPED CONTAINER filled with heated filler compound, is used to fill joints in concrete pavement.

LAST YEAR, as the result of original research conducted by Thomas E. Stanton, Jr., materials and research engineer, the California Division of Highways developed a combination of bitumen and commercial rubber latex to serve as an improved joint filler for concrete pavements. Among necessary qualities sought for in the new product were: (1) ability to seal openings against leakage of water; (2) adhesion to sides of concrete joint; (3) sufficient elasticity to fill joint opening during shrinkage of concrete due to temperature changes; (4) reasonable cost.

Essential characteristics of the bitumen-rubber latex combination are stickiness combined with low flowability at high temperatures and high ductility at low temperatures. The joint filler must be fluid enough to be readily placeable by ordinary construction methods and yet not so fluid as to run out of the crack or joint either at the time of construction or during subsequent warm weather.

Best Mixture Percentages—It was early determined that the best results are obtained with a mixture of approximately 70 per cent bitumen of the type used and 30 per cent rubber latex, the quality of the rubber latex being fixed by the grade of material commercially available. Though the bitumen is heated to between 150 and 200 deg. F. at the time of mixing with the latex and the joints poured while still warm, it was found that if anything harder than a comparatively soft grade of asphalt road oil, such as SC4, was used, the mixture stiffened during mixing to such an extent that it was not readily workable with ordinary hand-placing methods.

The mix adopted as a tentative standard, therefore, consists of 70 per cent SC4 oil and 30 per cent rubber latex, although further studies are being made with cut-back 90-95 road oil and E grade asphalts. Mixing temperatures must be maintained at 200 deg. F. or less in order to avoid foaming of the rubber latex, which is an emulsion of water and rubber. Several grades of SC4 oil were tried and it was found that the grade, source of supply or method of refinement plays quite an important part.

If the joint is to be placed by hand, the mixing must be done on the job and the joints poured while the mixture is still warm and of a workable consistency. It is impossible subsequently to soften by reheating a mixture which has been allowed to cool and harden before use.

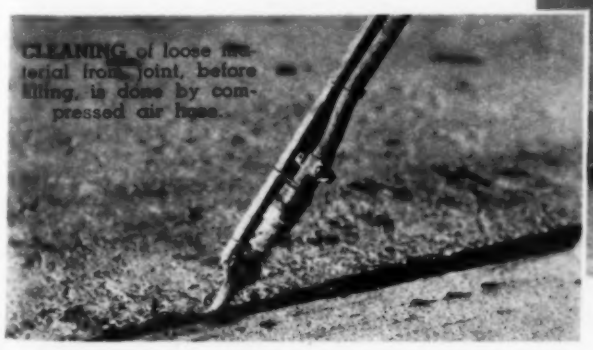
Cost of Material—At $180 per ton for rubber latex (when purchased in quantity) and approximately $10 per ton for the asphalt, the cost of material per ton of mix is as follows:

70 per cent bitumen by weight, at $10 per ton	$7.00
30 per cent rubber latex by weight, at $180 per ton	54.00
	$61.00

This is the cost per ton of crack filler, or approximately 24.4c. per gallon. If the seal in the expansion joints, ½ to ¾ in. wide, is poured to a depth of 1½ to 2 in., approximately a gallon of material will be required for each joint in a 20-ft. wide pavement at a cost of less than 25c. per joint for the material alone.

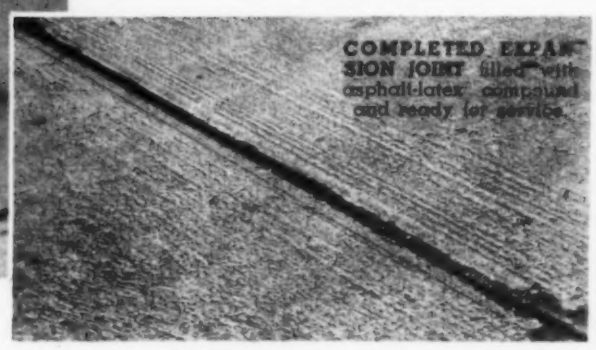
In from 4 to 6 hr. one man can readily mix and pour all joints in a day's placement run of 20-ft. pavement at a total average cost of not over 40c. per joint depending, of course, on the progress of the paving. At a combined cost of 65c. per joint for labor and material, the cost per mile for expansion joints spaced 100 ft. apart would be $34.32.

Crack Filler—In order that the asphalt-rubber latex filler may flow readily into shrinkage cracks, it has been found necessary to thin the filler with gasoline or other suitable solvent. No difficulty has been experienced in obtaining good penetration and thorough sealing of the cracks with this fluid material which stiffens as soon as the volatile constituents have evaporated.



CLEANING of loose material from joint, before filling, is done by compressed air hose.

STILL ELASTIC after one year's service in slab.



COMPLETED EXPANSION JOINT filled with asphalt-latex compound and ready for service.

Sub-Oiling Machine and Two Traveling Mixing Plants

Apply Bituminous Binder to Soil Roads

HYDRAULIC PISTONS controlled by levers in operator's hands regulate depth to which hollow drill teeth of mechanical sub-oiler are lowered into loose soil of roadway. Asphalt pump at rear of sub-oiler draws bituminous material through hose from tank truck and distributes it to hollow teeth through manifold system. Teeth are about to be lowered into loose soil.

DRAWN FORWARD by 75-hp. oil-engine tractor, sub-oiler injects asphalt emulsion below surface of loose soil across 7½-ft. width of roadway, 31 hollow drill teeth making parallel furrows at uniform 3-in. spacing.

TWO types of bitumen-cemented soil road, one produced by sub-oiling and the other by traveling mixing plant, are undergoing their first winter in service on Kentucky State Road 10, west of Greenup, where the Ralph E. Mills Co., Frankfort, Ky., in August and September built a little more than 20 mi. of asphalt- and tar-bound roadway base 22 ft. wide and 5 in. thick, under the direction of the State Department of Highways. The project was almost equally divided between the two types, sub-oiling being utilized on 10 mi. at the east end and traveling plant-mix on the remaining 10.7 mi. to the west.

Experimenting with various procedures and different types of bituminous material, the Department of Highways attempted to determine the most economical and effective method of constructing bitumen-cemented soil-road base. A careful check was kept on the gradation and inherent stability of the soil in the existing road, and the bituminous content of the mixture was adjusted in accordance with the gradation of the material, particularly in relation to the portion passing the 40-mesh sieve and to the percentage of sand, silt or clay in these fines passing the 40-mesh.

Following the actual construction of the bitumen-bound stabilized base, the contractor last fall gave the surface a prime coat of tar and pea gravel. Next spring, the Department of Highways will add a light armor coat to the surface. At the unit prices bid for base construction, the average cost per mile was $5,740 by the sub-oiling process and $6,100 to $10,000 by the traveling mixing plant process. These costs are exclusive of additional coarse aggregate, which was added in varying quantities to the plant-mix sections only, and likewise are exclusive of the tar prime and pea gravel.

Rapid progress was made in the construction of the bitumen-cemented soil base. Starting sub-oiling on Aug. 20, an Ingalls sub-oiler of the Midwest Pre-Cote Co., Kansas City, Mo., completed its 10 mi. of road on Sept. 11, working 12 hr. a day 6 days a week. On the initial 4.9-mi. stretch of plant-mix base, an old Barber-Greene traveling plant made slower progress, being delayed at several points by breakdowns resulting from the age of the equipment. When operating, the machine ran 24 hr. a day 7 days a week and completed the 4.9 mi. between Aug. 15 and Sept. 11. For the final stretch of practically 6 mi. of plant-mix, the old machine was joined by a second Barber-Greene plant, of larger capacity, only 1 year old. The new plant built the entire 6-mi. section with the exception of 1 full day when the older unit worked in combination with it. Both traveling mixing plants belonged to S. G. Hayes, of Chicago, who was associated with the Ralph E. Mills Co. in the contract.

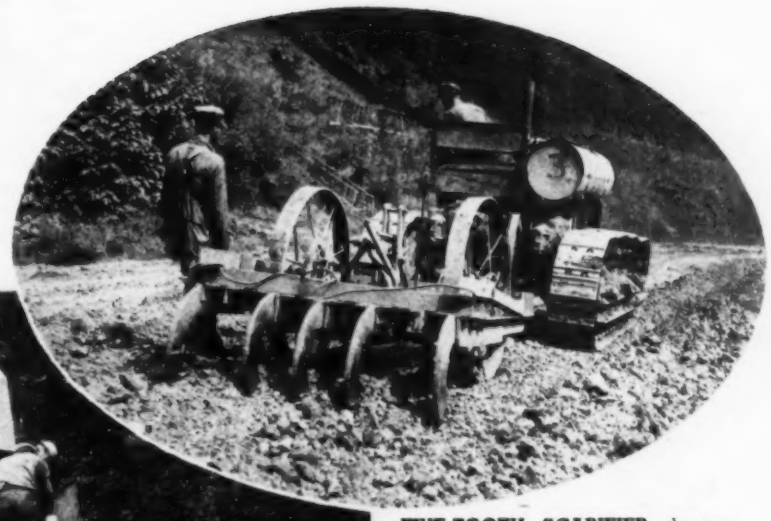
To keep up with the traveling mixing plant and with the sub-oiling

TRAVELING MIXING PLANT picks up windrowed roadway soil at front of machine and discharges continuous stream of bituminous soil mixture at rear. Small pump on subgrade at left of traveling plant takes water from tank truck and delivers it to auxiliary tank on mixer. Machine here halts temporarily to allow workmen to replace shaft at top of bucket loader.

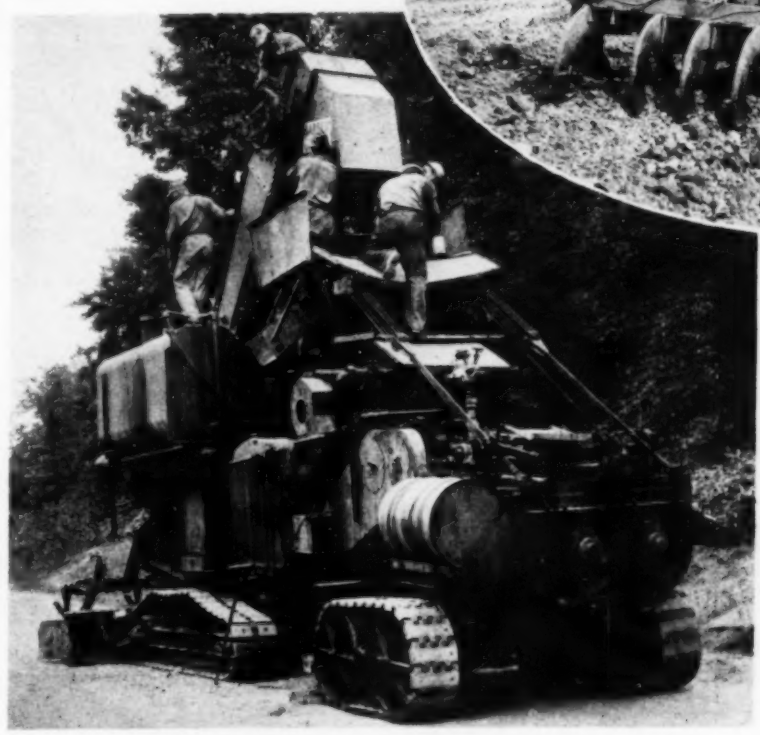
machine, an imposing array of auxiliary equipment was required to perform the essential operations of (1) scarifying and pulverizing the existing road in advance of bituminous applications and (2) blading, tamping and rolling the material behind the sub-oiling and mixing units. This equipment comprised eight track-type tractors (including 80-hp. diesels, 75-hp. electrical-ignition oil-engine units, as well as 60- and 30-hp. gasoline tractors), two pneumatic-tired agricultural-type tractors, three scarifiers (one of them being a 7,000-lb. three-tooth rooter), three disk harrows (the largest weighing 2,850 lb. unloaded), three power patrol graders, three blade graders, two three-wheel power rollers (weighing about 9 tons each, one steam and one gasoline), one pneumatic-tired roller, three double sheepsfoot rollers, one single sheepsfoot roller, two orchard cultivators and one spike-tooth harrow. To haul water and bituminous material to the mixing machines and to the sub-oiler, the contractor made use of twelve tank trucks of 850- to 1,175-gal. capacity. Asphalts and tar for the mixing plant were unloaded at a convenient railroad siding where a steam boiler and a superheater quickly raised the temperature of the materials to the desired point. Practically the entire sub-oiled section was built with emulsified asphalt of 60 per cent asphaltic content. A compact and efficient emulsifying plant, to produce the necessary emulsion under subcontract, was erected by the Highland Co., Louisville, Ky., at a nearby railroad siding.

Existing Road — No changes were made in grade and alignment of the existing road. For about 17½ mi. west of Greenup this road in past years had received a light coating of gravel followed by bituminous treatment which formed a wearing course about 1-in. thick. In this portion of the road were included all of the sub-oiling section and about half of the traveling plant-mix section. With the exception of the thin surface mat mentioned, the remainder of the roadway cross-section on practically the entire project consisted of sand-silt material, with clay occurring in some places.

Preparation of Roadway—For both the sub-oiling and plant-mix operations, the existing roadway had first to be scarified and pulverized to the depth required to give a finished, compacted thickness of 5 in. This work was accomplished by equipment already listed, which made as many trips over the roadway as were required to produce the necessary pulverizing of the material.



FIVE-TOOTH SCARIFIER drawn by 60-hp. gasoline tractor breaks up soil of existing road prior to disking and sub-oiling.

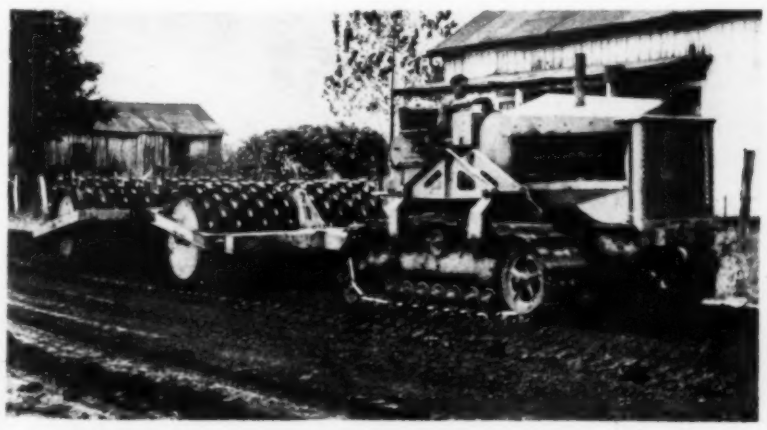


LARGER TRAVEL PLANT, with proved productive capacity of 2.4 cu.yd. of bituminous soil mixture per minute, is assembled on road prior to building final 6 mi. of plant-mix section.

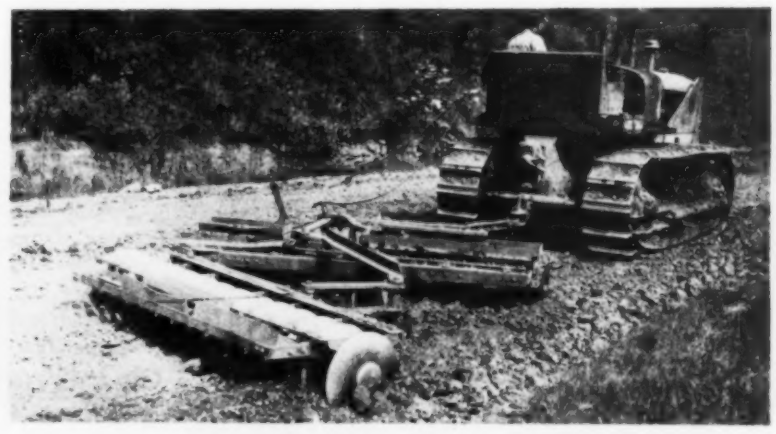
On the sub-oiling section the scarified, pulverized soil was left in its original position, struck off to desired grade and cross-section, in readiness for the application of water and oil. For the plant-mix process, the pulverized soil was picked up by motor patrol graders and was worked across the roadway into a center windrow for one mixing plant (or into two parallel windrows for two traveling plants, during the few hours when the two units operated in combination). The blading operation left the subgrade trench trimmed to proper grade and cross-section profile, with earth shoulders of correct depth to hold the bituminous soil mixture when it would be spread and compacted behind the traveling plant. Lateral ditches through the shoulders provided drainage for the trenched subgrade.

Sub-Oiling Process—In brief, the sub-oiling process calls for a properly pulverized soil in the roadway to be wet first with water. After water has been introduced into the soil the material receives bituminous applications injected below the surface of the roadway at the depth desired for the finished base. The water in the soil moves upward and expels the air from the voids and pores in the material. Following the water comes the oil, filling the voids and pores of the soil as the water evaporates, until the oil completely permeates the soil up to the surface of the roadway.

To inject oil below the surface in accordance with this theory the Midwest Pre-Cote Co. uses an Ingalls sub-oiling machine equipped with 31 hollow drill teeth through which oil is pumped under pressure. In the heel of each tooth is an aperture through which the oil is discharged into the soil. The teeth are arranged on a tubular frame in such a way as



DOUBLE SHEEPSFOOT ROLLERS hooked in tandem behind 80-hp. diesel tractor compact tar-sand mixture produced by traveling mixing plant process.



ONE-WAY DISK HARROW drawn by 75-hp. oil-engine tractor follows five-tooth scarifier, further breaking down lumps of sand-silt- clay soil. Behind this unit comes two-way disk harrow drawn by 30-hp. gasoline tractor.

to give a 3-in. spacing between oil outlets across a 7½-ft. width of roadway. Three vertical hydraulic pistons, by which the tubular frame is suspended from the main carriage, control the depth to which the teeth are lowered into the roadway soil.

A tractor pulls the pneumatic-tired carriage on which the sub-oiling equipment is mounted. In connection with the drawbar of the sub-oiling machine is a fourth hydraulic piston which assists the operator in steering. The drill teeth, 31 in number, are connected by a manifold system to an asphalt pump, mounted on the machine, which draws oil from a tank truck following in the rear.

UNUSUAL EQUIPMENT (right) for road construction job is pneumatic-tired agricultural tractor drawing single sheepsfoot tamping roller. Unit compacts loose soil after second application of asphalt emulsion by sub-oiling machine.

TAR-SAND MIXTURE produced by traveling plant receives regular shaping by fast motor control grader during compaction period.

Construction Steps—Specifications required for the soil fraction of the roadway material (passing a 40-mesh sieve) moisture contents roughly approximating the following percentages: For sand, not less than 7 per cent; for silt, not less than 10 per cent; for clay, not less than 15 per cent. Water in the average amount of 2 gal. per square yard had to be added to the disked and harrowed roadway soil to give the needed moisture for proper functioning of the sub-oiling process.

For the first 6 mi. of the sub-oiling section west of Greenup, the contractor applied the water on the surface from a tank truck and worked the moisture into the soil with agricultural cultivators. On the remaining 4 mi. of the section the water was introduced directly into the soil by the sub-oiling machine at a depth of 3 in. below the surface of the loose material.

Within a short time after the introduction of the moisture the sub-oiling machine made its first application of bituminous material. Specifications permitted this material to be introduced in two or more applications, and the contractor elected to use two applications throughout the work. The practice on the job was to place the first application 6 in. below the surface of the uncompacted soil and the second application about 3 in. below the surface. Between applications, the surface was bladed and disked to close furrows left by the teeth of the sub-oiling machine. Usually the two applications were made the same day.

For practically the entire sub-oiling section the bituminous material was an asphalt emulsion with a 60-per cent bitumen content. The engineers in their efforts to determine the best mixture varied the amount of 60-per cent emulsion from 3 to 4.8 gal. per square yard of roadway. At the finish of the section the quantity of asphalt emulsion used had been adjusted to 4.3 gal. per square yard, equal to about 25 gal. per cubic yard of material. This quantity was introduced into the soil in two equal applications of 2.15 gal. each.

As a variation from asphalt emulsion the engineers on one 940-ft. section tested a slow-curing asphalt applied by the sub-oiling machine. To obtain satisfactory dispersion through the soil, it was found necessary to mix the material with disk harrows and blades, following the application of the asphalt. No mixing operation was required where asphalt emulsion was used, as the emulsion dispersed rapidly through the soil without the aid of any external agent.

Following the final application of bituminous material the roadway was rolled to preliminary compaction with sheepsfoot tamping rollers. The surface then was lightly bladed and was rolled with one of the 9-ton three-wheel rollers. Blading and rolling were repeated at intervals during the following 10 days or two weeks until the contractor obtained a smooth, firm, well-compacted surface acceptable to the engineers.

Cost of Sub-Oiling—Progress with the sub-oiling machine was rapid. In a 12-hr. day the machine could make two applications of bituminous material on 3,000 lin.ft. of 22-ft. by 5-in. roadway base.

Depending upon the amount of 60 per cent asphalt emulsion used, ranging from 3.0 to 4.8 gal., the cost of sub-oiled section varied from $5,040 to $7,270 per mile. Average cost for the entire section was $5,741 per mile. For the final quantity of 4.3 gal. of 60 per cent emulsion, arrived at by the engineers toward the end of the sub-oiled section, the cost per mile was $6,650. Emulsified asphalt, paid for on the basis of the bid price of 8c. per gallon for 50 per cent emulsion, was the major item in cost, ranging from $3,717 to $5,948 per mile. The bid price for manipulation was $1,200 per mile, and the average cost of water was $123 per mile.

Emulsifying Plant — Successful emulsifying of the asphalt required soft water and proper control of the asphalt temperature. Water was pumped from the Ohio River and softened in a home-made plant with Zeolite sand. For rapid and economical emulsifying, the manager of the plant regulated the temperature of the asphalt at about 245 deg. F. and ran the emulsion at 165 to 170 deg. F. Three 10,000-gal. asphalt cars were heated at one time.

Actual emulsifying was done by a Grifonel process machine, illustrated by an accompanying photograph. The plant was equipped with two emulsifying tanks having a capacity of about 1,200 gal. each. Emulsion was produced in volume units of 1,180 gal., some 12 to 15 min. being required to produce this quantity, depending on the temperature of the asphalt. For simplification, the process will be described as it would be performed to produce 1,000 gal. of emulsion containing 60-per cent asphalt. To mix this volume, the tank first would be filled with 400 gal. of soft water, to which the emulsifying agent (resin residue and lye) would be added. The water and dissolved emulsifying agent then would be started through the emulsifying machine. At this point the operator would open the asphalt valve on the line from the car. The pump, turning 2,150 r.p.m., whips the asphalt and water. During the emulsifying process, the water passes through the pump and squeezing machine seven

MULTIPLE-PNEUMATIC-TIRED ROLLER loaded with stone and drawn by 50-hp. oil-engine tractor compacts plant-mix bituminous soil mixture after material has been spread between earth shoulders of trenched subgrade.

or eight times. At the end of the process, the volume in the tank is built up to a total of 1,000 gal., including the 600 gal. of added asphalt.

Traveling Plant Mix — Four types of bituminous material entered into the 10.7 mi. of traveling plant-mix base construction. In accordance with the engineer's directions, the contractor built 1.1 mi. of plant-mix base with 60-per cent asphalt emulsion, slightly less than 1 mi. with medium-curing asphalt and a little more than 1 mi. with medium tar. For the remainder of the section, about 7.7 mi. in all, the soil was mixed with slow-curing asphalt.

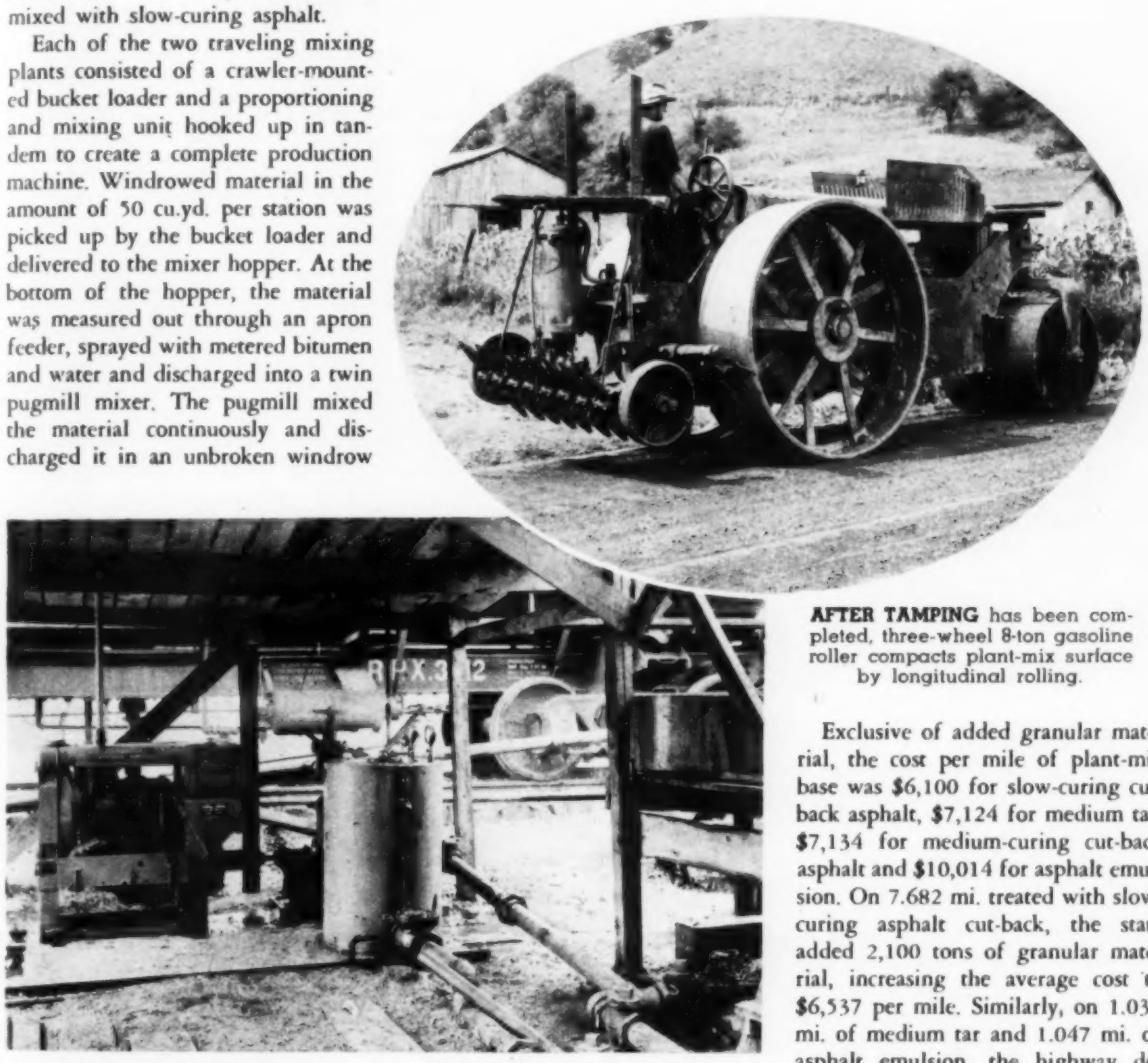
Each of the two traveling mixing plants consisted of a crawler-mounted bucket loader and a proportioning and mixing unit hooked up in tandem to create a complete production machine. Windrowed material in the amount of 50 cu.yd. per station was picked up by the bucket loader and delivered to the mixer hopper. At the bottom of the hopper, the material was measured out through an apron feeder, sprayed with metered bitumen and water and discharged into a twin pugmill mixer. The pugmill mixed the material continuously and discharged it in an unbroken windrow on the road at the rear of the machine. Speed of the traveling plant was adjusted to produce a homogeneous mixture, uniform in color.

Once the proper controls had been set by the engineers or inspectors, the proper proportioning of the three ingredients of the mixture in the continuous mixing operations was automatic. Calibrated control gates under the hopper could be set to feed the proper quantity of soil to the apron feeder. The bitumen pump was interlocked with the apron feeder to maintain a constant ratio regardless of engine speed or other factors. All bituminous materials except the emulsion were heated to spray readily.

Necessary water for wetting the soil particles and causing complete dispersion of the bituminous material throughout the mixture, with resultant complete coating of the soil particles, was pumped from a tank wagon or tank truck to an auxiliary water storage tank on the traveling mixing plant. From this tank, water was delivered to the mixer by a pump connected to the same drive as the bitumen pump, assuring that the proportion of water always would be maintained in constant ratio to the bitumen content and volume of soil.

In the portion of the base where slow-curing cut-back asphalt was used the traveling mixing plant added 16.3 gal. of bituminous material and about 45 gal. of water to each cubic yard of finished mixture. The same proportion of bituminous material and water applied roughly to other portions of the plant-mix base, where medium curing cut-back asphalt and medium tar were employed in the mixture. Specifications provided for the traveling plant-mix section the following maximum rates of application for a 7-in. loose depth of mixture: water, 1½ gal. per inch of depth per square yard; asphalt, ½ gal. per inch of depth per square yard.

Cost of Plant-Mixed Base—Maximum progress obtained on this work by the older travel plant was 1.9 cu.yd. per minute. The newer, larger-capacity travel plant had demonstrated a maximum productivity of 2.4 cu.yd. per minute on previous work performed in Missouri.



AFTER TAMPING has been completed, three-wheel 8-ton gasoline roller compacts plant-mix surface by longitudinal rolling.

EMULSIFYING MACHINE driven by gasoline power plant produces 1,180 gal. of 60 per cent asphalt emulsion in 12 to 15 min., passing water from emulsifying tank through pump and squeezing machine seven or eight times during process.

Exclusive of added granular material, the cost per mile of plant-mix base was $6,100 for slow-curing cut-back asphalt, $7,124 for medium tar, $7,134 for medium-curing cut-back asphalt and $10,014 for asphalt emulsion. On 7.682 mi. treated with slow-curing asphalt cut-back, the state added 2,100 tons of granular material, increasing the average cost to $6,537 per mile. Similarly, on 1.039 mi. of medium tar and 1.047 mi. of asphalt emulsion, the highway department added 100 tons and 200 tons, respectively, of granular material, producing final average costs of $7,278 and $10,320 per mile. No gravel was added to the section, 0.932 mi. long, in which medium-curing asphalt cut-back was used.

On the various sections of plant-mix base the contractor used 330,000 gal. of slow-curing asphalt cut-back, 42,000 gal. of medium tar, 48,300 gal. of medium-curing asphalt cut-back and 94,000 gal. of asphalt emulsion (adjusted to basis of 50 per cent emulsified asphalt). The same sections took water in the following quantities: 970,000 gal., 110,300 gal., 99,100 gal. and 89,100 gal. Manipulation of plant-mix base cost $2,350 per mile.

Contract Unit Prices

KENTUCKY BITUMINOUS STABILIZATION

Sub-Oiling Process	
Manipulation, per mile	$1,200.00
Granular material, per ton	1.80
Water, per 100 gal.	.50
Emulsified asphalt, per gallon	.08

Traveling Mixing Plant Process	
Processing base, per mile	$2,350.00
Hauling and windrowing granular material, per ton	1.60
Water, per 100 gal.	.60
Emulsified asphalt, per gallon	.08
Cut-back asphalt, MC-3, per gallon	.08
Cut-back asphalt, SC-3, per gallon	.07
Medium tar, per gallon	.10¼

Finishing Plant-Mixed Base — Within 12 hr. after the traveling plant had completed the mixing, the mixed material was given its preliminary spreading across the subgrade by motor patrol or blade graders. Finishing operations usually started within 72 hr. after the material had been mixed. Immediately prior to finishing the mixed material was spread across the subgrade to a uniform depth except for small windrows formed at the two edges. Compaction then was undertaken by rolling with multiple pneumatic-tired rollers and sheepsfoot tamping rollers. This rolling started while the moisture content of the mixed material was slightly above the optimum for compaction, and the tamping continued until the tamper feet produced no impression exceeding 1 in. in depth. During the operation a blade grader maintained a surface of uniform cross-section.

Immediately after the tamping the 9-ton three-wheel rollers compacted the surface by longitudinal rolling until complete compaction had been obtained. Both in the earlier tamping and in the final rolling of the base, the rollers started at the edge of the roadway and progressed toward the center, overlapping on successive trips by at least 6 in.

Administration — Robert Humphreys, commissioner of highways, is chief executive of the Kentucky Department of Highways. All engineering activities of the department are directed by T. H. Cutler, state highway engineer. Actual construction of the experimental project here described was carried out under the general supervision of G. L. Logan, director of construction. Sampling and testing of soils and bituminous materials were responsibilities of the Highway Department's testing laboratory, with C. C. Cantrell, engineer of tests, in charge. J. Niel Morris, resident engineer, was in direct charge of all operations on the project for the State Department of Highways.

For the general contractor, the Ralph E. Mills Co., Frankfort, Ky., construction operations were directed by R. E. Palmore, superintendent.

Soil-Cement Stabilization

in South Carolina

By W. H. MILLS, Jr.
Testing Engineer, South Carolina Highway Department

TRAVELING MIXING PLANT (above and left) of Barber-Greene design, equipped with inclined bucket conveyor, picks up at one pass sufficient windrowed material from subgrade **(left)** to lay a 6-in. compacted base on a 20-ft. width of roadway. Over pug-mill mixer at rear is wood platform **(above)** from which cement is handled to proportioning hopper. Cement-soil mixture is deposited in windrow from rear of machine.

SUPPLEMENTING earlier experimental work, the South Carolina Highway Department, during the last year, completed 18.4 mi. of cement-stabilized road base. Of this mileage, 15.3 mi. were constructed under contract and 3.1 mi. by the department's own forces.

One project of approximately 0.5 mi. was designed to give information on the minimum quantity of cement which would satisfactorily stabilize soil. The soil in this experiment was a red clay soil typical of that found in a large area of the state. It contained no coarse material, 40 per cent clay and had a plasticity index of 25. According to usual laboratory tests, which included alternate wetting-drying and freezing-thawing on specimens of soil with various percentages of cement molded at optimum moisture content, it was concluded that 9.5 per cent of cement, by volume, would be required for stabilization. This quantity was reduced to 7.5 per cent for one section and to 6.5 per cent for the other section.

Usual methods for mixed-in-place procedure were followed in constructing all three sections. The section containing 6.5 per cent cement did not harden as rapidly as the others, but there have been no failures in this project during the six months it has been subjected to traffic. In designing this project the idea was to reduce the quantity of cement for one section below the minimum required for stabilization in order to have field information which could be correlated with laboratory durability tests to use as a criterion in setting the cement content for future work in similar soils. Failures are expected to develop in the section containing 6.5 per cent of cement.

Hampton Project—During last winter the C. G. Fuller Co., of Barnwell, S. C. constructed the first cement-stabilized base which has been let to contract. This project consisted of a 10.5 mi. section of Route 63 in Hampton County. The specifications required a completed base 22 ft. wide, 6 in. thick, compacted, covered with a mixed-in-place bituminous wearing surface ½ in. thick and 20 ft. wide. The bid price for the base was $0.495 per square yard and for the surfacing $0.18 per square yard. Work was begun on Dec. 5, 1936, and the last of the base was placed on May 6, 1937.

The contractor used a traveling mixing plant for mixing operations. The soil was scarified and windrowed to the center of the road. Canvas was used to protect the soil in the windrow and subgrade during bad weather. Due to the season in which the project was constructed, adverse weather delayed operations in many instances. The subgrade for this type of construction must be sufficiently dry to support compaction by sheepsfoot rollers, and the use of the canvas to protect both the soil and subgrade proved very beneficial. The soil was picked up from the windrow by the traveling mixing plant and placed in a bin from

SHEEPSFOOT ROLLER consolidates soil-cement mixture after it has been spread uniformly across width of roadway.

PROTECTION of windrows of soil-cement mix during rains is accomplished by canvas covers.

which it flowed through a measuring gate into the pug mill. Cement was applied from a bin attached on the platform of the mixer. The measuring gate for the cement was interlocked with the measuring gate from the soil bin so that cement was applied at a constant rate.

The moisture content of the soil in the windrow was within the requirements on many sections and, when necessary, to increase the moisture to the optimum for compaction, water was applied to the mixture after the cement had entered the pug mill. The completed mixture was discharged from the end of the pug mill, shoveled into place by hand and packed with a sheepsfoot roller operated back and forth parallel to the center line of the road. When the feet of the sheepsfoot roller had compacted the mix to about 1½ in. of the top, the surface was bladed to the correct grade and cross-section, compaction planes were removed by light scarifying, and the mulch thus obtained was compacted with loaded trucks or a pneumatic roller. The final surface was obtained with a multiple-blade drag, but the riding qualities of the road were not entirely satisfactory due to the short sections which had to be worked in many instances.

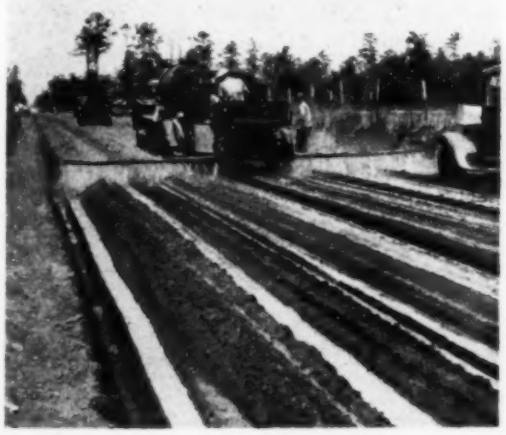
construction occurred in a section of the road 0.5 mi. long. This failure appeared only after the base had been surfaced and under traffic for a short time. The surfacing shoved, and it was discovered that the top of the cement stablized base was soft to a depth of about 1 in. No serious trouble has developed from this failure and it has been necessary to patch only a few square yards.

Union Project—The C. G. Fuller Co. was awarded the contract at 48c. per square yard for

ods similar to those on the Hampton project, but obtained a much better riding surface. Progress has been slow due to adverse weather conditions but approximately 4.8 mi. have been completed at this writing. In one week a total of 11,500 lin.ft. was constructed.

Highway Department Projects — The highway department constructed with its own forces several miles of cement-stabilized roads in different parts of the state. These projects consisted of 1.8 mi. on U. S. Route 178, between Saluda and Greenwood; approximately 0.5 mi. in the town of Estill; 0.5 mi. at Clemson; and 0.25 mi. near Greenville. Regular mixed-in-place procedure was followed in the construction of all of these projects. Compacted depths varied from 4 to 6 in., depending on traffic, and cement contents were varied to suit the soil encountered.

The project between Saluda and Greenwood was the repair of a bituminous surfaced road which has always given trouble because of bad subgrade and inferior top soil base. The old surface treatment was broken by scarifying and this loosened material was included in the mix. Cement was applied at the rate of 8 per cent, by volume, and



MIXED-IN-PLACE METHODS for soil-cement mixtures, as compared with plant-mix on opposite page. **(Above)** Spreading cement from truck. **(Left)** Applying water with wide sprinkler bar. **(Right)** Mixing with blade grader. **(Below)** Disking cement into soil at start of mixing.

The soil in this project varied from almost pure fine sand to soil containing as much as 25 per cent clay. Cement amounting to 8 per cent, by volume, was used with the sandy soil and 10 per cent with soil containing considerable clay. No curing was used for any of the base, but in most instances weather conditions were favorable to retarding evaporation of moisture.

During the construction of this project the necessity for a stable subgrade was definitely shown when an attempt was made to construct short sections over subgrade which was too wet. Cracking appeared during final compaction and the mix did not harden satisfactorily. The base at these locations was reconstructed. A 4-mi. section of this project was primed with tar in March 1937 and soon afterwards "blow-ups" occurred in 23 places. These blow-ups were characterized, in a few cases, by cracking and shattering of the base for the full depth for approximately 2 ft., but in most places only the top 2 in. were visibly affected by shattering, although there was one crack completely through the base. Shattered portions of the base were removed and easily patched with soil-cement mixture. There has been no recurrence of this trouble nor has it appeared on any other project of this kind. A failure due to improper

the cement stabilized base and 18c. per square yard for the bituminous surfacing for 7.8 mi. of Route 92, near Union, S. C. Specifications for this work are similar to those on the Hampton project. The soil on this project in most instances consists of disintegrated granite which gives very excellent results in the laboratory durability tests; only 6.5 per cent by volume, of cement was used with this soil. However, the cement content was increased to 9 per cent, by volume, when red clay soil was encountered. The contractor used equipment and method regular procedure was followed for mixing, compacting and smoothing the surface. Due to heavy traffic it was necessary to construct the road in half-sections, and after completion the cement-stabilized base was covered with a ½-in. bituminous mat.

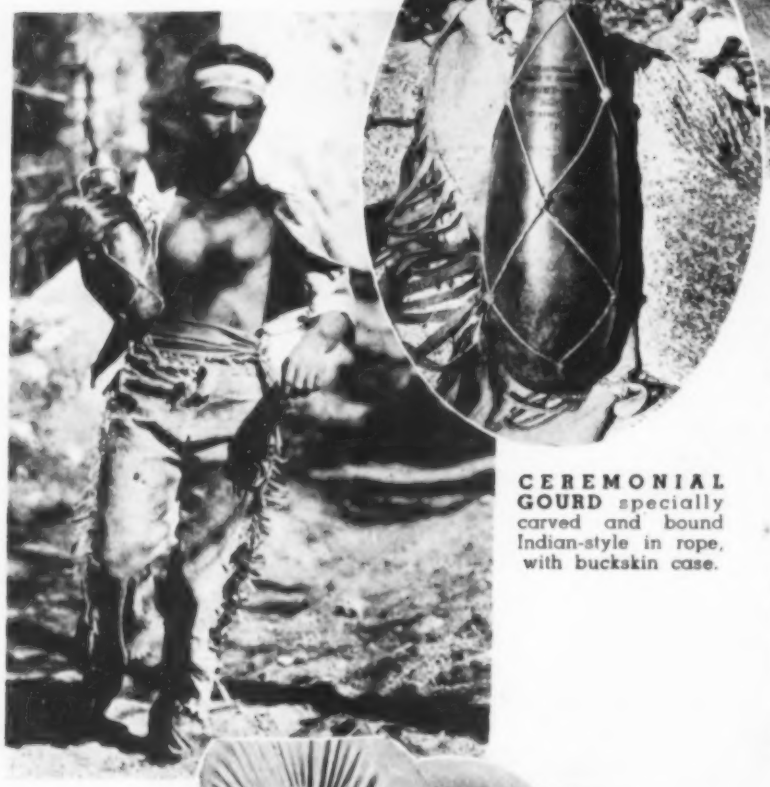
The last-named project has not been completed for a sufficient time to judge the adequacy of the stabilization, but it is believed that this project will furnish a severe test of cement stabilization, as the subgrade is very plastic clay and unstable in wet weather. A portion of this project was stabilized with another material in order to compare the economy and durability of the two methods as there is considerable mileage of bituminous-surfaced roads which could be repaired if either method proves economical and durable.

Contracts have been let for 13 mi. more of cement-stabilized roads and bids have been requested on this type as an alternate to others on 15.3 mi. Much remains to be learned about designing and constructing this type of road and both the laboratory and field forces are engaged in studying the different problems. The work to date has shown that adequate preliminary investigations and careful field control are essential to the successful construction of cement stabilized roads.

TRANSPORTATION PAGEANT

DESERT HIGHWAY (right) between Mt. Whitney and Death Valley, in California, with Panamint Sink in background.

INDIAN RUNNER (below) starts ceremonial gourd, filled with water from Lake Tulainyo, on first lap of its journey to Death Valley.



CEREMONIAL GOURD specially carved and bound Indian-style in rope, with buckskin case.

COLORFUL PAGEANTRY, depicting progressive stages in the progress of transportation, starting with an Indian runner and ending with an airplane soaring over a mountain peak, marked the dedication at Bad Water, Calif., Oct. 31, of the first major unit, 17.6 mi. long, of the Lone Pine-Death Valley highway, built for the California Division of Highways by The Peninsula Paving Co., of San Francisco. During a 3-day celebration a ceremonial gourd was filled with mountain water from Lake Tulainyo, 12,865 ft. up Mt. Whitney, highest

TWENTY-MULE TEAM, which hauled borax out of Death Valley in early days, relays gourd on its journey along new highway in Bad Water.

OLD-TIME PROSPECTOR (right), with burro, turns gourd over to covered wagon occupied by young woman descendant of member of Manly party which suffered many hardships in crossing Death Valley in 1849.

STAGE-COACH, with Ollie Dearborn, veteran driver, handling reins and Gov. Merriam with rifle, as guard, transports gourd to special train at Keeler Junction.

Opens Highway Into California's Death Valley

point in the United States, carried by various means across country and finally emptied into the brackish slime of Bad Water, 275 ft. below level, lowest point in America, signalizing the Marriage of the Waters through the instrumentality of modern transportation facilities.

AIRPLANE receives gourd at Panamint Dry Lake and completes last leg of journey to Bad Water where gourd is dropped into sub-sea pool, consummating the Marriage of the Waters.

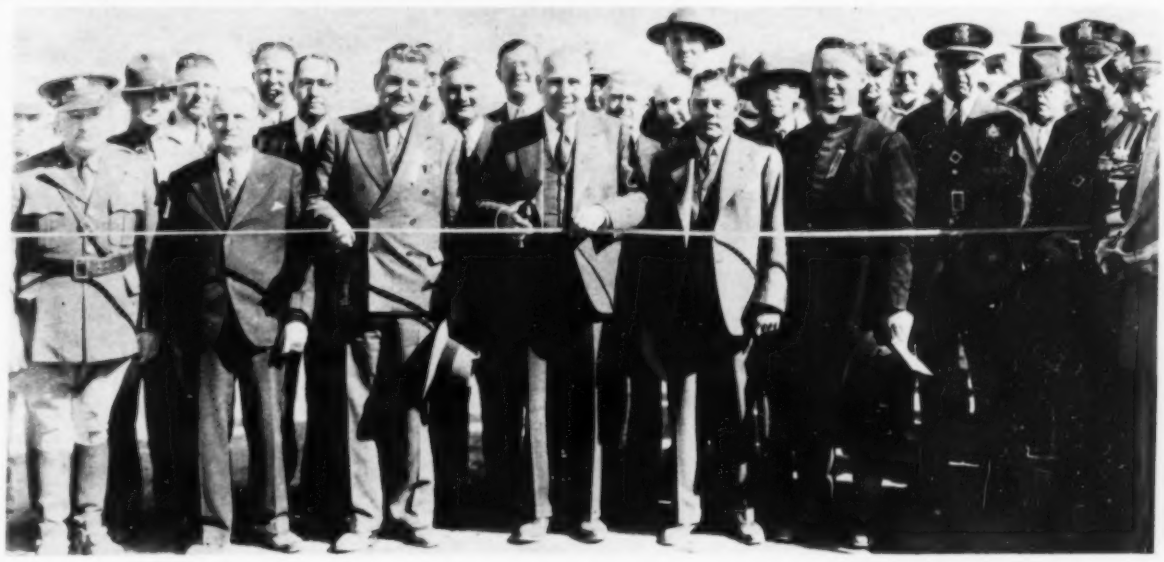
AUTOMOBILE (above) driven by Louis Mayer, famed racing driver, receives gourd from locomotive engineer and carries it to point of transfer to airplane.

AT RAILROAD CROSSING (left) gourd passes from stage-coach to old-time steam locomotive running on narrow-gage track into Keeler, old borax town.

SHOOTING (below), instead of snipping with scissors, is method employed by Gov. Merriam to sever ceremonial ribbon and open new highway to traffic.

After the delivery of the gourd at its destination, Governor Frank F. Merriam departed from standard ceremonial technique in opening new highways to traffic. Instead of snipping with scissors a ribbon strung across the route, California's chief executive, true to Western tradition, drew a gun and shot down the barrier.

In the pageant marking the opening of the new highway, the ceremonial gourd of water in its journey from Mt. Whitney to Death Valley, was transported, in sequence, by Indian runner, pony express rider, pioneer prospector on burro, ox-drawn covered wagon, 20-mule team, stage coach, old steam locomotive, streamlined automobile and airplane.

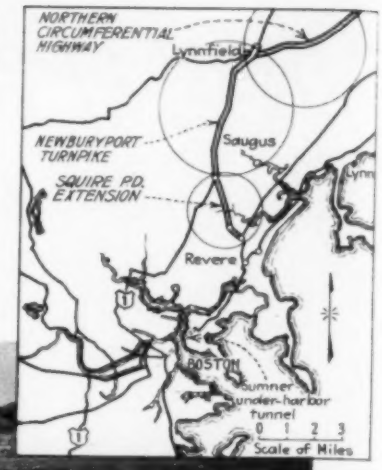


Two Types of

ASPHALT PAVEMENT

On Divided-Lane Highways North of Boston

LOCATION MAP (right), shows relation of three construction projects to state highway system outside Boston.



OPERATING under the direction of the Massachusetts Department of Public Works on three connecting or intersecting projects north of Boston, E. H. Lewis, of Andover, Mass., the C. J. Maney Co., Inc., of Boston, and B. Perini & Sons, Inc., of Framingham, Mass., last fall completed the grading, paving and grade separation bridges for 12 mi. of divided-lane highways on arterial and circumferential routes penetrating or bypassing the metropolitan district. The three contracts have an aggregate value of almost $3,200,000, and the total cost

PRODUCING 1,100 TO 1,200 TONS in two 7-hr. shifts, large-capacity asphalt plant equipped with 2-ton twin-pugmill mixer supplies asphaltic concrete to four black-top paving machines working on two contracts. For these contracts plant produces 92,000 tons of asphaltic concrete for roadway pavement and about 4,000 tons for pedestrian sidewalks and surfacing of grade separation bridges.

PENETRATION MACADAM PAVEMENT of special type furnishes wearing course for roadways of Squire Road Extension, which here crosses peat bog from traffic circle in foreground to two grade separation bridges to be seen dimly in left background. With exception of some curved white concrete slope edging, all curb used around inclosed areas of this improvement is granite.

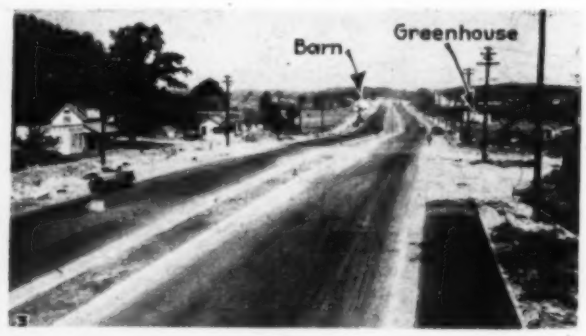
of the improvements will exceed $3,500,000. This expenditure is justified by predictable traffic volume for the improved roads, which are designed with central separating strips between multiple-lane roadways of unusually ample width, located to easy grades and curvatures on broad rights-of-way, with sidewalks to serve pedestrians in all settled districts.

At all important roadway intersections the highway design provides grade separation bridges or traffic circles. Grading and paving contracts in all cases called for the loaming and grass-seeding of roadway slopes and inclosed areas, in addition to the preparation of loam pits for future planting of shrubbery and trees by the Department of Public Works.

Roadways are paved either with a hot plant-mix asphaltic concrete or with asphalt penetration macadam of a special type. Both of these pavements are built to rigid specifications which produce durable, smooth-riding pavement, possessing a non-skid surface. For practically their entire length, the roadways are lined along both edges with granite curb or precast concrete slope edging. At each depression in the roadway catch basins, set flush with the surface of the pavement and recessed slightly into the curb, carry away surface water to underdrains or culverts.

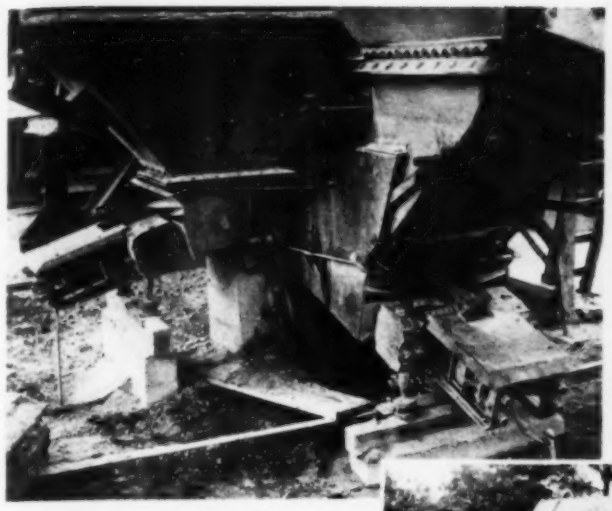
Three Projects—An accompanying pavement cross-section indicates typical roadway design for the Newburyport Turnpike contract, largest of the three here described. The locations of this improvement and of the two contiguous projects on the Northern Circumferential Highway and the Squire Road Extension are shown on the map. Right-of-way for the Newburyport Turnpike improvement is 133 ft. wide, and for each of the other improvements is 100 ft. wide.

B. Perini & Sons, Inc., graded and paved 4.68 mi. of the Newburyport



THREE STAGES IN CONSTRUCTION OF NEWBURYPORT TURNPIKE DIVIDED-LANE HIGHWAY IMPROVEMENT

1. EXISTING TWO-LANE MACADAM ROAD carries traffic at start of new construction, indicated by preliminary grading, at right, for one roadway of divided-lane highway. **2. WHILE OLD ROAD,** at left, continues to carry traffic, grading and paving for one roadway proceed alongside on right-of-way widened to 133 ft. In foreground is base course of asphaltic concrete pavement placed on 14-in. compacted gravel sub-base. **3. NEARING COMPLETION,** divided-lane highway displays two 44-ft. roadways, each made up of 34-ft. asphaltic concrete pavement and 10-ft. asphalt penetration macadam lane adjacent to outside granite curb. White concrete slope edging marks outlines of central separating strip ranging from 10 to 20 ft. wide.



VIBRATING FEEDERS under manually adjusted discharge gates of sand and stone bins feed aggregate to cold stone elevator at uniform, easily regulated rate. Vibrators operate at constant speed of about 3,600 r.p.m. Amplitude of vibration is determined by rheostat control on motor-generator set which supplies direct current to electro-magnets of vibrator units.

ASPHALTIC CONCRETE PAVEMENT laid on sub-base of 14-in. compacted gravel consists of 3-in. base course and 2½-in. wearing course, latter being placed in two layers, 2-in. intermediate layer and ½-in. top layer. Trucks have tracked some sand and soil from sub-base on to three layers of pavement.

BETWEEN TRUCKLOADS (below) of asphaltic concrete mixture, mechanical spreader continues forward motion until material in hopper is exhausted.

SELF-PROPELLED BITUMINOUS SPREADING MACHINE takes asphaltic concrete base mixture from dump truck and distributes it uniformly across 11-ft. lane on compacted gravel sub-base. While discharging load, truck and spreader move forward together.

CREW OF FORKERS behind bituminous spreader places base mixture against steel edge form, where machine cannot operate because of interference with reciprocating strikeoff screed.

Turnpike under a contract amounting to almost $1,350,000. The same firm built three grade separation bridges on the same project under a separate contract priced at nearly $170,000.

E. H. Lewis built 3.95 mi. of divided-lane highway on the new Northern Circumferential Highway, with one grade separation bridge, under a contract awarded at a price of almost $845,000. For most of the distance each roadway provides a 23-ft. traveled way with a 9-ft. shoulder, paved for 3 ft. and asphalt-treated for the rest of its width.

Squire Road Extension, built almost entirely on new location, provides a direct connection between the Sumner under-harbor tunnel (leading into downtown Boston) and the Newburyport Turnpike (U.S. 1). The design for this improvement called for two 30-ft. roadways surfaced with a macadam pavement consisting of a 12-in. gravel sub-base, a 4-in. sand-bound broken stone base and a 2½-in. asphalt penetration top constructed by the same special process as used in the parking lane on the Newburyport Turnpike. The project, 2.93 mi. in length, was awarded to the C. J. Maney Co., Inc., at a bid price of slightly more than $825,000, which included the construction of two grade separation bridges, one crossing a railroad and the other crossing a highway.

Asphaltic Concrete Paving — Both E. H. Lewis and B. Perini & Sons, Inc., subcontracted their paving work to the Southampton Paving Co., of Boston. An outstanding feature of the paving operations was the equipment employed by the subcontractor to furnish and place asphaltic concrete on the two projects. A Warren Bros. asphalt plant was set up adjacent to a commercial quarry and crushing plant, within 2 mi. of both jobs, and supplied mixed materials for the pavement. The plant had a capacity of more than 100 tons an hour; for a period of two months it averaged 1,100 to 1,200 tons per 14- to 16-hr. day.

DRYER, 6 ft. in diameter by 30 ft. long, equipped with six burners, handles wet aggregate at rate of more than 90 tons an hour. From sand and stone bins charged by clamshell crane in right background, aggregates are fed to dryer at uniform rate by vibrating feeders. In foreground, truck driver is oiling body of truck while awaiting his turn to drive under plant and take load of five batches from 2-ton mixer.

This output was taken with ease by four Adnun black-top pavers, working two on each project. Excess capacity was provided by the four paving machines, the contractor figuring small time losses by the paving crews to be cheap insurance against costly shutdowns of the asphalt plant.

Asphalt Plant — A crew comprising a foreman and 5 men took care of all operations at the asphalt mixing plant and maintained daily production of 1,100 to 1,200 tons in two 7-hr. shifts.

Plant capacity was governed by the rate at which aggregate could be dried in a 72-in.x30-ft. dryer equipped with six Gem burners. This unit was capable of drying extremely

TWO ROLLERS (right), an 8-ton tandem and a 12-ton three-wheel, compact 3-in. asphaltic concrete base course behind spreading machine. Raker and hand tamper at right are smoothing and compacting material around curved form at catch basin.

wet aggregate at a rate of 90 to 100 tons an hour. Feeding aggregate to the cold-sand elevator at the intake end of the dryer were two Jeffrey vibrating feeders, operated by electromagnets at 3,600 r.p.m., one under the sand bin and the other under the stone bin. These units fed the aggregate to the elevator in a uniform, readily controlled stream, the feeding rate being regulated by rheostat controls on the a.c. motor-d.c. generator set which supplied energy to the two vibrators. A single operator controlled the vibrating feeders and adjusted the burners in the dryer. In both of these duties he was aided by an indicating pyrometer in the boot of the hot-stone elevator.

At the upper end of the hot stone elevator, four Robbins vibrating screens separated the aggregates into four sizes which dropped into their respective pockets of the four-compartment bins. A 4,000-lb.-capacity twin pugmill mixer produced 2-ton batches of asphaltic concrete for the two paving jobs. Aggregates for each batch were weighed with the aid of a Howe dial scale, of 5,000-lb. capacity, which registered cumulative weights of material in the aggregate weigh box. Asphalt cement was weighed in a steam-jacketed asphalt bucket by a beam scale equipped with underweight and overweight controls.

Reserve supplies of crushed rock and sand were stockpiled by a gasoline crane with a 1¼-yd. clamshell bucket, which fed these materials to the primary bins of the asphalt plant. Stone went into a 150-ton two-compartment steel bin and sand into a 75-ton bin. The vibrating feeders controlled the passage of aggregates from manually adjusted gates under these bins to the cold-stone elevator.

Asphalt was trucked to the plant and was stored in two tanks, holding almost 10,000 gal. each, equipped with steam-coil heating chambers which permitted direct pumping of hot asphalt from tanks to mixer. For potential requirements on other jobs, the plant was designed with a 150-hp. boiler, although 50 hp. would have been adequate at this site. Fuel oil was stored in an 8,000-gal. tank.

Mixed batches of asphaltic concrete were hauled from the plant to the road by heavy pneumatic-tired trucks which carried five batches, or 10 tons, per trip.

Asphaltic Concrete Mixtures

Roadway pavement on both the Lewis and Perini contracts consisted of patented Warrenite Bitulithic wearing course 2½-in. thick (laid in two courses) on a 3-in. asphaltic concrete base. The Southampton Paving Co., acting as licensee of the patent owner, furnished patented mixtures at a definite price offered to the State Department of Public Works for the use of all bidders prior to the taking of bids. Furnishing of base mixture (unpatented) and spreading and compacting of the three courses were additional functions undertaken by the Southampton Paving Co. as a result of separate agreements with the low bidders.

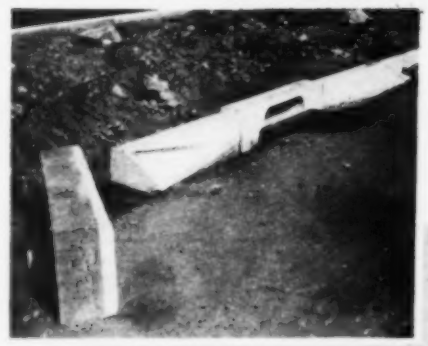
Bituminous concrete base course contained 4 to 6 per cent bitumen and aggregate up to 1½ in. in size. Mixing requirements for the base were the same as for the two layers of the wearing course, known respectively as the coarse surfacing mixture and the granular surfacing mixture. Specifications set the steps of the mixing operation as follows: (1) Aggregates larger than ½ in. are drawn from respective bin compartments, are accurately weighed and are run into a twin pugmill mixer; (2) about one-half of total amount of bitumen then is added; (3) finer sizes of aggregate are weighed and run into mixer; (4) remaining bitumen is added; (5) mixing is continued for at least 50 sec. before discharge gate of mixer is opened.

Coarse surfacing mixture for the 2-in. intermediate course of the pavement contains stone up to 1¼-in. maximum size and 20 to 35 per cent fine aggregate passing a No. 10 screen. Of the fine aggregate passing the No. 10 sieve, taken here as 100 per cent, from 8 to 15 per cent must pass the 200-mesh sieve.

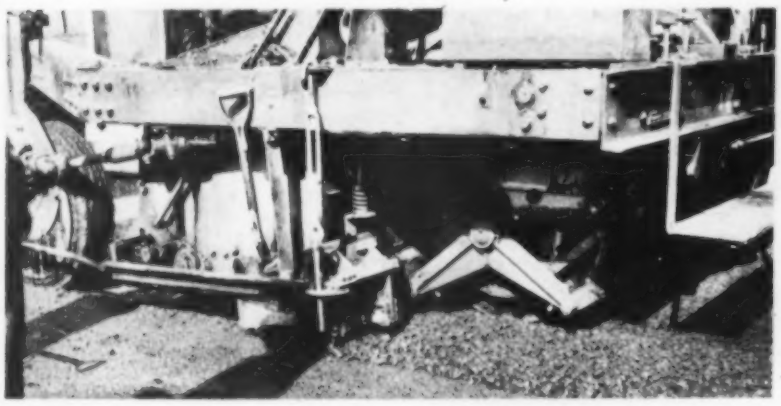
All aggregates in the granular surfacing mixture, according to the specification, must pass ⅜-in. round openings, and 20 to 35 per cent must pass the 10-mesh sieve. This fine material must meet the same 200-mesh specification as do the fines for the coarse surfacing mixture.

Paving Operations—Self-propelled black-top pavers equipped with hop-

CAST-IRON TOP of catch basin **(right)** is recessed slightly into white concrete slope edging. Special cast units of white concrete serve to accommodate catch basin. Resting on pavement at left is typical precast block of slope edging, 8 in. thick by 1 ft. wide by 4 ft. long, with the upper 2-in. consisting of white-cement concrete. These units are cast by contractor on job.



STEEL FLOOR FRAMING and concrete details of typical grade separation bridge crossing Newburyport Turnpike.



COARSE SURFACING MIXTURE for intermediate layer 2 in. thick is spread and struck off by black-top paver. Two pairs of tandem rollers serve as rear supports for surfacing machine. Note hand shovel stuck in side frame of paver to prevent material from spreading over adjacent lane.

SAND-BOUND BROKEN STONE BASE for penetration macadam wearing course on parking lane is compacted to 2-in. thickness by 10-ton three-wheel roller of modern design.

ers, rotating shaft feeders and reciprocating strikeoff screeds spread the mixed material for each of the three courses of asphaltic concrete pavement—a 3-in. base, a 2-in. intermediate layer and a ½-in. top. These pavers were of a type which has come into widespread use in the last few years. The machines were propelled by gear-driven front guide wheels and by two pairs of tandem rollers which served as rear wheels. A wide opening between the front guide wheels permitted an end-dump truck to back into the hopper and keep the paving machine charged with material until the truck body was emptied.

Two black-top pavers operated simultaneously on separate lanes of one roadway. Ordinarily the two units laid base during the first stage of the paving operation and followed up this construction on the following morning, or later in the same day, by placing the intermediate layer and top layer of the wearing course. The two layers of the wearing course required different mixtures which were sent out by the plant in the proper ratio to keep the top close to the intermediate layer.

On this work the paving subcontractor for the first time placed a bituminous concrete course as thin as ½ in. with black-top pavers. Previously it had always been the contractor's practice to spread any layer as thin as ½ in. by hand raking, and at the beginning of the job the customary large crew of hand spreaders and rakers had been used to distribute the ½-in. top course. A trial of the paving machines quickly demonstrated that they produced a smoother surface at a great saving in labor and time, and the black-top pavers continued to lay all three courses to the end of the job.

LOAM FOR LANDSCAPING SLOPES (right) along Northern Circumferential Highway is deposited by Dumptor which hauls it from borrow area. In background is bridge over Lowell St., with men at left spreading crushed rock for sand-bound base of penetration macadam pavement on connecting ramp between separated grades at this intersection.

TYPICAL GRADE SEPARATION BRIDGE (below) crossing Newburyport Turnpike consists of two steel girder spans resting on concrete abutments and center bent.

TO SCATTER COVER STONE (left) uniformly on seal coat of asphalt penetration macadam pavement, contractor uses rotary spreader driven by one-cylinder gasoline motor having two speeds.

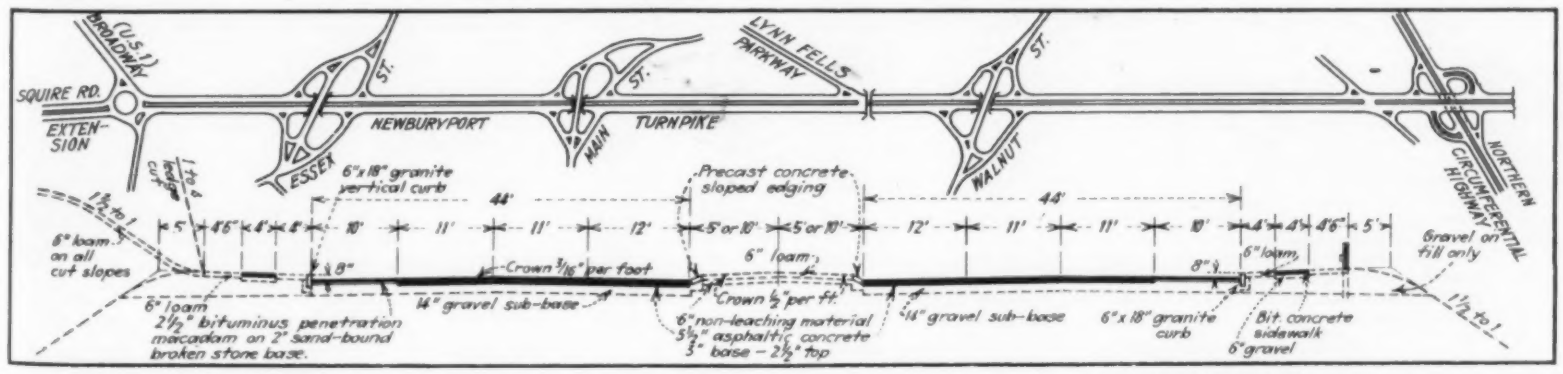
Edges of the asphaltic concrete pavement were held by steel road forms, as required by specifications. The forms were set to accurate grade and alignment prior to final finish of the gravel sub-base to permit close checking of the cross-section profile with a rolling scratch templet.

Surface variations exceeding ¼ in. in 10 ft. are prohibited. This specification applies to the base and to each course of the pavement construction. When this subgrade requirement is met, the specifications permit pavement finishing by a machine with a longitudinal wheelbase of approximately 8½ ft. or more. The Adnun black-top pavers, with a span of 8.2 ft. between the front guide wheels and the forward pair of tandem rear rollers, satisfied the wheelbase requirement.

Both the 3-in. base course and the 2½-in. wearing course (the latter placed in two layers) were thoroughly compacted by rolling with an 8-ton tandem and a 12-ton three-wheel roller, each powered by a gasoline engine. Only light compression with the 8-ton tandem roller was given the 2-in. coarse surfacing layer of the wearing course. While this layer was still in a workable condition to allow intimate bonding, granular surface mixture was spread to the desired depth, and the two layers were rolled with a 12-ton roller to give a compacted total thickness of 2½ in.

On both the base course and the wearing course, longitudinal rolling started at the edges wherever possible and proceeded toward the center. Longitudinal rolling was followed by

LEDGE EXCAVATION on Newburyport Turnpike is loaded by diesel shovels into 12-yd. steel truck bodies of Boulder Dam type.



SCHEMATIC LAYOUT indicates roadway planning at four grade separations on Newburyport Turnpike. **CROSS-SECTION** reveals types of construction employed in two 44-ft. roadways and in pedestrian sidewalks.

diagonal rolling in two directions and by cross rolling. Adjacent to the forms, the material was compacted by hand tamping.

Penetration Macadam Pavement—After placing a 12-in. gravel subbase on Squire Road Extension, the C. J. Maney Co. built a 4-in. base of sand-bound 2-in. stone and laid on it a 2½-in. wearing course of patented Penolithic penetration macadam, similar to that constructed in the parking lane on the Newburyport Turnpike job. Aggregate for the surfacing course consisted of a combination of three sizes: Coarse aggregate made up of stone from 2 in. to 1 in. in size was spread upon the prepared base with the aid of spreader boxes pulled forward by dump trucks as the trucks unloaded. A 10-ton three-wheel roller compacted the aggregate to the desired depth of 2½ in. by longitudinal rolling, starting at the sides and proceeding toward the center of the pavement. The compacted surface was checked to eliminate deviations greater than the specified tolerance of ¼ in. in 10 ft.

After the rolled surface had been brought to true grade and cross-section, it was sprayed by pressure distributors with a sufficient quantity of patented oil to assure coating of all the particles. This oil roughly approximated the color and consistency of clear water. An application of ⅛ gal. per square yard was adequate for 2½ in. of broken stone.

To the oil-treated coarse aggregate a pressure distributor applied hot asphalt cement having a temperature of 325 to 375 deg. F. at a rate of about 1.25 gal. per square yard. Following the application of hot asphalt, the 10-ton three-wheel roller gave the surface further longitudinal rolling properly to seat the particles of coarse aggregate.

WITH WATER-LEVEL CAPACITY INCREASED from 8 cu.yd. to 9 cu.yd. by addition of 6-in. steel lip to sides of body, fleet of truck trailers, numbering fifteen in all, handles bulk of earth moving for Newburyport Turnpike.

Construction of the wearing course was completed by an application of keystone to fill the surface course, followed by a second application of asphalt cement and a final application of pea stone on top of this seal coat. Both the keystone and the pea stone were treated with the special mobile oil prior to their distribution on the pavement. This oil treatment required from 1½ to 3 gal. of oil per cubic yard.

Keystone consisted of intermediate-size aggregate ranging from ¾- to ¼-in. Between 20 and 30 lb. of oiled keystone per square yard was spread over the asphalted surface of the coarse aggregate and was broomed to cover the pavement uniformly. The roller worked the keystone into the surface course and bonded them thoroughly. Asphalt cement to the amount of about 0.4 gal. per square yard then was applied by pressure distributor.

Following this application of asphalt seal coat, pea stone ranging from ½-in. to 10-mesh in size, previously treated with oil, was spread over the surface in a thin layer and was rolled until thoroughly bonded to the pavement. During the rolling, additional fine aggregate was spread and broomed over the surface to produce a uniform coating. The total application of cover stone amounted to 15 to 25 lb. per sq. yd. On the following day, the 10-ton three-wheel roller gave the surface of the pavement a thorough back rolling.

Grading—All three contracts called for grading as well as for paving. Quantities involved in the grading operations are indicated by the accompanying tables of contract quantities and prices.

Grade Separation Bridges—A total of seven grade separation bridges is involved in the improvements on the three highways. Without exception these structures are steel girder and concrete design. All except the one railroad crossing on the Squire Road Extension are built across highways. Where the lower highway at the grade separation is divided-lane type, the bridge is built in two spans, with a center pier in the separating strip between the two roadways.

One bridge of this kind was built under separate contract by Richard White Sons, Inc., at the north end of the Newburyport Turnpike improvement, where this traffic artery crosses over the relocated Northern Circumferential Highway. This bridge is of particular interest because it is faced with brick and contains, in its north abutment, garage space for maintenance equipment.

Administration—William F. Callahan, commissioner of public works, is chief executive and administrator of the Massachusetts State Department of Public Works. All engineering activities of the department are under the direction of George H. Delano, chief engineer. Construction work on the three contracts mentioned in these notes was carried out in conjunction with the federal government under the supervision of J. A. McCarthy, district engineer, and J. E. O'Neil, construction engineer, District 5, with headquarters at Beverly, Mass. Those directly in charge of work on the improvements were Lewis J. Fritz, resident engineer on the Newburyport Turnpike and Squire Road Extension, and J. F. McCarthy, resident engineer on the Northern Circumferential Highway.

Partial List of Contract Quantities and Prices

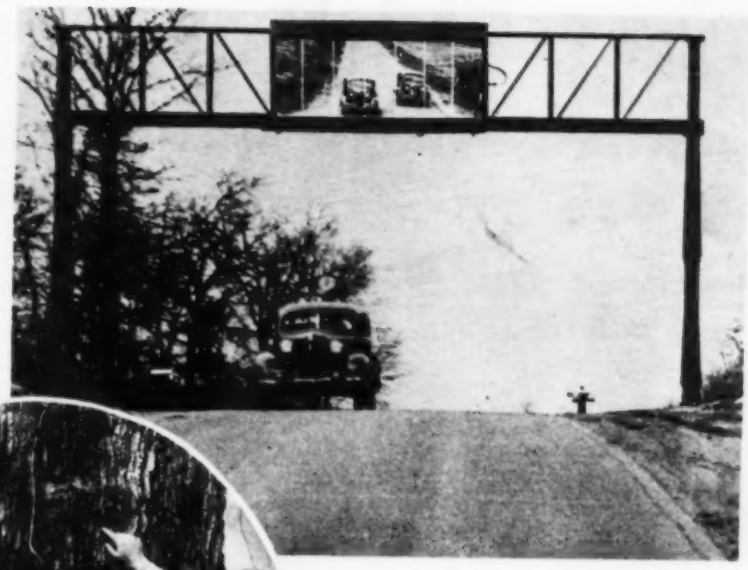
THREE MASSACHUSETTS HIGHWAY CONTRACTS

	Newburyport Turnpike			Northern Circumferential Highway			Squire Road Extension		
Item	*Quantity*	*Unit Bid Price*	*Total Bid Price*	*Quantity*	*Unit Bid Price*	*Total Bid Price*	*Quantity*	*Unit Bid Price*	*Total Bid Price*
Roadway earth excavation, cu. yd.	204,400	$ 0.36	$ 73,584.00	360,100	$ 0.20	$ 72,020.00	46,600	$0.30	$13,980.00
Ledge excavation, cu. yd.	93,100	1.81	168,511.00	48,300	1.35	65,205.00	39,000	2.50	97,500.00
Ordinary borrow, cu. yd.	323,500	0.38	122,930.00	—	—	—	354,600	0.45	159,570.00
Broken stone for roadway base course, cu. yd.	9,510	3.15	29,956.50	3,240	3.00	9,720.00	22,220	1.55	34,441.00
Catch basins, each	292	55.00	16,060.00	237	80.00	18,960.00	176	65.00	11,440.00
Straight granite vertical 6x18-in. curb., lin. ft.	60,600	1.00	60,600.00	8,620	1.10	9,482.00	35,875	0.90	32,287.50
Fine grade rolled and finished, sq. yd.	551,000	0.05	27,550.00	356,000	0.03	10,680.00	260,000	0.03	7,800.00
Trench excavation, cu. yd.	26,000	1.25	32,500.00	23,800	2.30	54,740.00	15,500	1.20	18,600.00
Trench ledge excavation, cu. yd.	3,200	4.00	12,800.00	—	—	—	—	—	—
Loam borrow, cu. yd.	43,700	1.00	43,700.00	29,800	0.90	26,820.00	16,000	0.50	8,000.00
Peat excavation, cu. yd.	57,200	0.29	16,588.00	55,450	0.40	22,180.00	42,700	0.30	12,810.00
Precast concrete sloped edging, lin. ft.	43,000	0.65	27,950.00	37,430	0.40	14,972.00	860	1.25	1,075.00
Bituminous concrete surfacing for sidwalks, tons	1,980	8.00	15,840.00	700	8.00	5,600.00	840	6.75	5,670.00
Warrenite Bitulithic pavement incl. bit. conc. base course, sq. yd.	186,260	1.87	348,306.20	122,120	1.57	191,728.40	—	—	—
Oiled broken stone for Penolithic wearing surface, cu. yd.	7,790	4.59	35,751.10	3,260	4.50	14,670.00	19,490 tons	2.40	46,776.00
Bit. material for Penolithic wearing surface, gal.	224,000	0.08	17,920.00	83,000	0.11	9,130.00	256,200	0.085	21,777.00
Oiled broken stone for Penolithic base course for sidewalks, cu. yd.	2,075	4.59	9,524.25	700	5.50	3,850.00	1,690 tons	2.20	3,718.00
Bit. material for Penolithic base course for sidewalks, gal.	36,350	0.08	2,908.00	12,200	0.13	1,586.00	15,300	0.085	1,300.50
Gravel borrow, cu. yd.	232,200	0.57	132,354.00	133,900	0.35	46,865.00	96,700	0.50	48,350.00
Total value of items listed here			$1,195,333.05			$578,208.40			$525,095.00
Total value of contract		$1,349,895.25			$843,701.60			$825,178.15	

JOB ODDITIES

A MONTHLY PAGE OF

Unusual Features of Construction



TRAFFICSCOPE (left) safety device tested on state highway in Minnesota and involving reflector mounted on bridge at hill top, enables motorists to see approaching vehicles on opposite side of crest and avoid collisions.

RELICS of a bygone highway era in Maryland which passed its first road law in 1666. "Notch Roads" **(right and below)** were primitive thoroughfares leading to a town, church or meeting house. Number of notches blazed on tree told traveler where road led. Toll Rates **(below, at right)** were posted on Maryland's turnpikes in accordance with state law passed in 1804.

THE
THREE NOTCH ROAD
AN EARLY LAW PROVIDED THAT
"THREE NOTCHES OF EQUAL DISTANCE"
MARKED ON THE TREES INDICATED
A ROAD LEADING TO A FERRY.
"TWO NOTCHES WITH ANOTHER NOTCH
A DISTANCE ABOVE THE OTHER TWO"
A ROAD TO A COURT HOUSE.
"A SLIP CUT DOWN THE FACE
OF A TREE NEAR THE GROUND"
A ROAD TO A CHURCH.
STATE ROADS COMMISSION
RATES of TOLL
For every Score of Sheep
of Hogs
of Cattle
Every Horse & Rider or led Horse
Every Chair or Chaise, with one Horse & two Wheels
Every Carriage or Wagon with four Horses & four Wheels
For the same, with four Horses
Every Cart or Wagon, narrow tire
For each Horse drawing the same
Every Cart or Wagon broad tread,
Each Horse drawing the same
Two Oxen in draft equal to one Horse.
Every Mule equal to one Horse.

"The old lady's gonna' raise hell, Boss, when she finds out I'm using her sheets to cure this new concrete road slab."

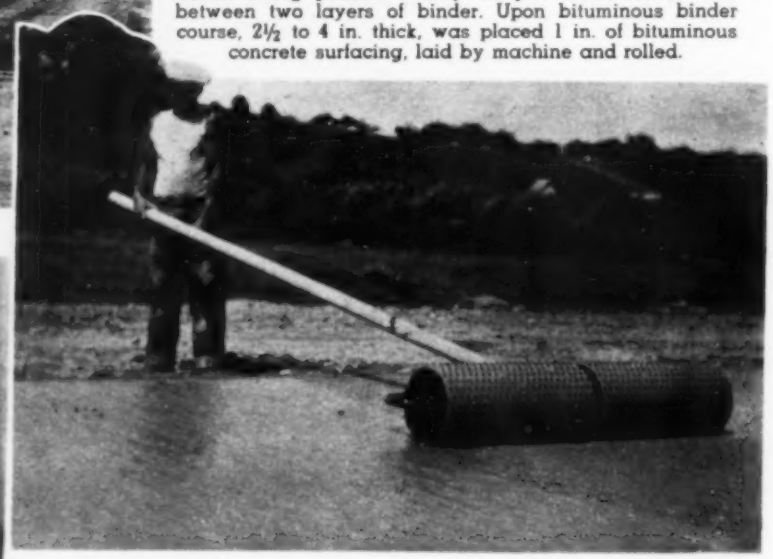
PAVER STOPS TRAFFIC of street car line on Franklin St., Chicago. Large number of public utility manholes in pavement prevented operating on subgrade. Street car company cooperated by diverting traffic during working hours, allowing paver of Robert R. Anderson Co., Chicago contractor, to occupy track area in street center. Mixer skip cleared trolley wires by 4 in.

GOLD FROM ROAD GRAVEL is obtained by M. E. Carlson Construction Co., of Denver, Colo., in operating its screening plant **(above)** on a paving job at West Colfax, just beyond city limits of Denver, Colo. At bottom of an inclined chute (in foreground of picture above) there is a screen and under screen a carpet. "After screening," Mr. Carlson writes, "gravel, which was discovered to contain a certain amount of gold, goes into bins and sand is wasted over inclined chute. In running over chute heavy gold settles down through riffles in screen. Sand is wasted and removed by a gasoline power shovel. We have recovered from this plant gold averaging about $160 per month, almost enough to pay operating expenses of gravel screening plant."

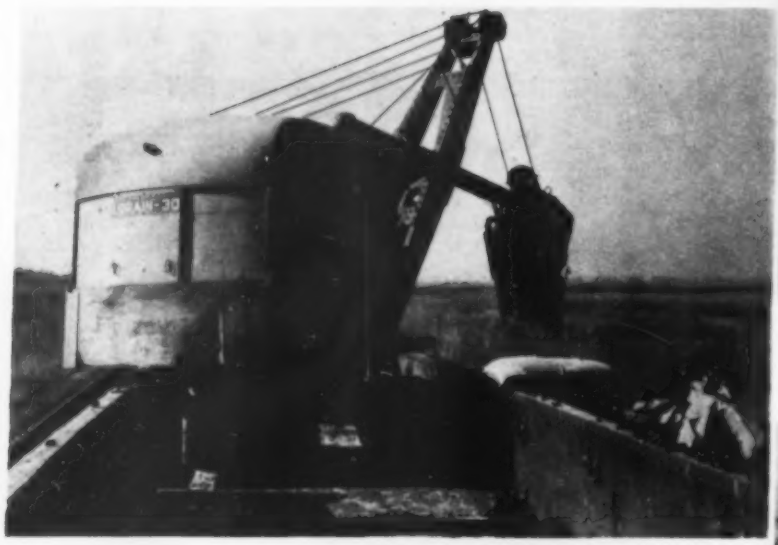
How They Did It

CONSTRUCTION DETAILS
For
Superintendents and Foremen

REINFORCED BITUMINOUS SURFACING (above and left) over old, broken concrete pavement is subject of experiment by Michigan Highway Department to test ability of wire mesh to prevent "rocking" under heavy traffic. Surface of concrete, originally laid without reinforcement, first received bond coat, after all cracks had been wedged and filled. Reinforcing mesh was given coat of cut-back asphalt before being placed directly on pavement, rather than between two layers of binder. Upon bituminous binder course, 2½ to 4 in. thick, was placed 1 in. of bituminous concrete surfacing, laid by machine and rolled.



"PORCUPINE" ROLLERS with cylindrical surfaces studded with projecting "quills" to work down coarse aggregate, are furnished, without cost, to contractors by Oregon State Highway Department for finishing concrete pavement.

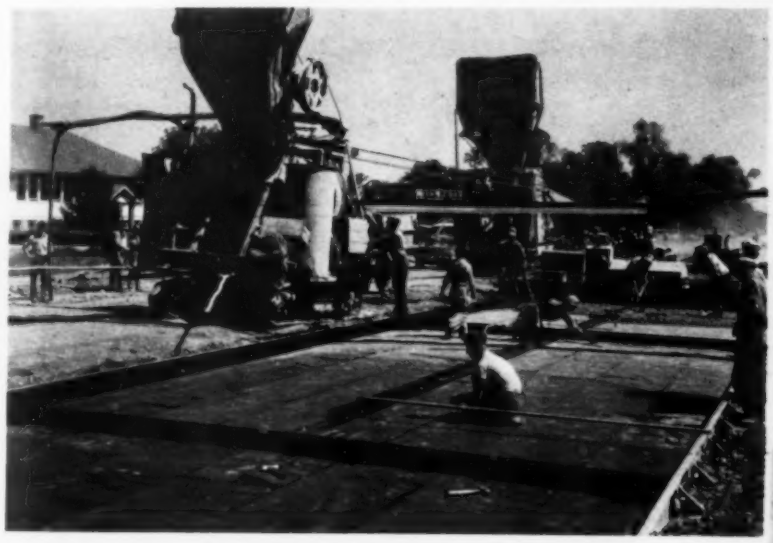


UNLOADING AMESITE for paving runways of new Philadelphia airport at Hog Island, Pa., is done by ½-yd. dipper of Lorain shovel owned by Hutchinson Contracting Co and operated in open-end gondola railroad cars. Shovel moves through string of cars as material is unloaded.

GRADER LEVEL ATTACHMENT regulates height of blade's cutting edge for preparing shoulder trench to receive road oil mix on California highway job. Rubber-tired caster wheel, 2 ft. in diameter, with swivel action, is attached to one end of moldboard by welded bracket, bored to receive 1-in. vertical shaft. Position of wheel, riding on pavement surface, is fixed by collars and set-screws. When trenching for shoulder alongside pavement, section of blade is cut out to allow portion of moldboard to project over pavement. Blade level is later adjusted to cut compacted shoulders to ½ in. above grade to allow for settlement. Attachment was devised by H. J. Doggart, resident engineer, and used by Peninsula Paving Co. **— Photo from California Division of Highways.**

CRIB WING-WALLS on grade separation structure at Freeport, Me., permit State Highway Commission of Maine, at minimum expense, to undertake future widening or second span for additional tracks.

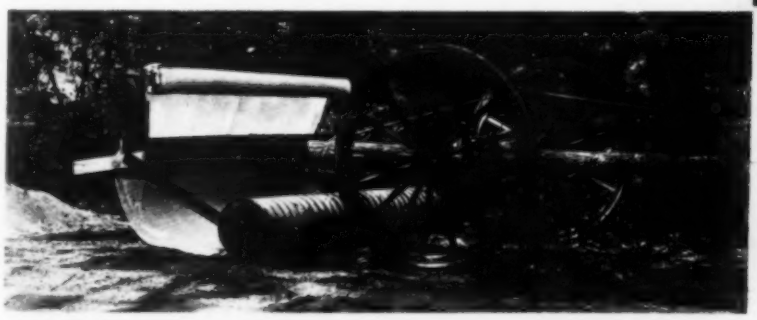
DECORATIVE BRICK FACING is applied to grade separation bridge of Massachusetts Department of Public Works on Newburyport Turnpike at Lynnfield, Mass. Structure involves two steel girder spans on concrete abutments and center piers. Left abutment of bridge provides garage space for road maintenance equipment. Contractor was Richard White Sons, Inc.



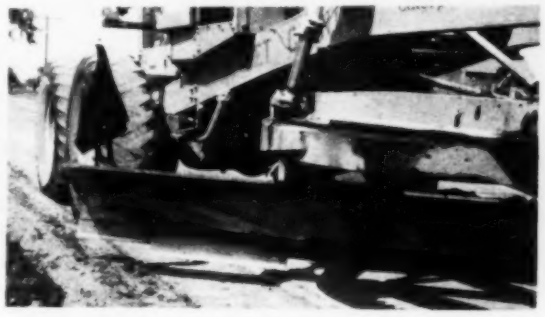
ASPHALT-SATURATED PAPER in strips with 4-in. overlap, is placed by Kentucky Department of Highways on subgrade of divided-lane concrete highway between Louisville and Middletown, to prevent absorption of water in concrete, while curing, by subgrade material. In foreground are center strip metal air chamber expansion joints and sealed metal contraction joints.

STREAMLINED BACK SLOPES are prepared by Nebraska Department of Roads, using hand labor and tools in Clay County.

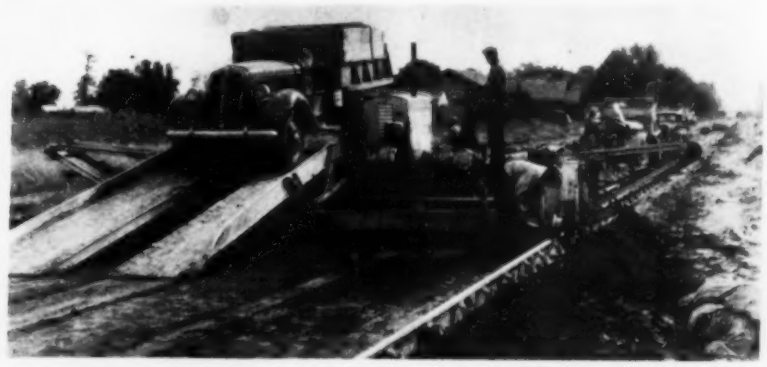
SHOULDER SHAPER consisting of machine with extension blades, hauled by tractor, proves effective on 20 mi. of Wisconsin highway. Device prepares shoulder to receive gravel surfacing 10 ft. wide, 4 in. deep at pavement edge and 1 in. deep at outer edge.



COTTON-LAYING MACHINE with rolls mounted on two-wheeled truck, is used by Massachusetts Department of Public Works to place strips of fabric on Route 62 near Wilmington, prior to covering with bituminous surface treatment.



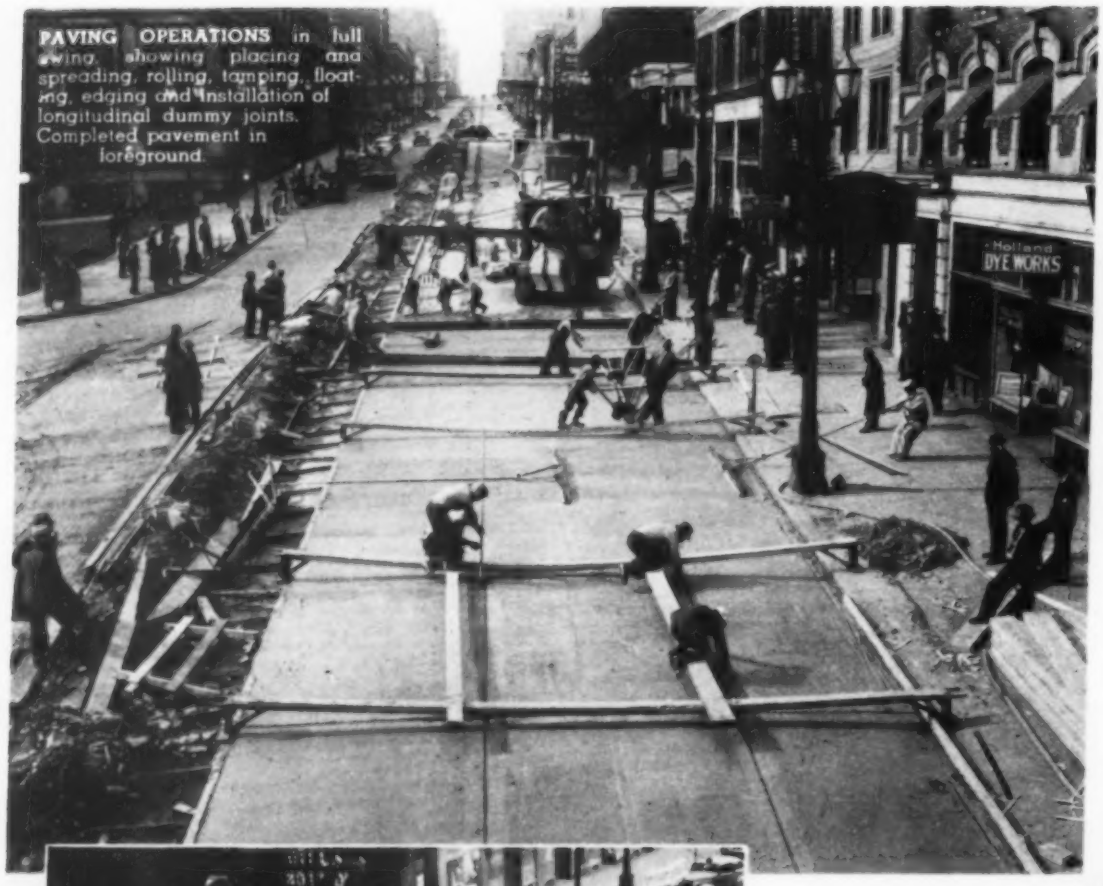
TRENCHING DEVICE (right) with projecting cutting edge near end of grader blade, prepares subgrade of road shoulder, adjacent to pavement, prior to placing gravel or bituminous surface by Wisconsin Highway Commission.



BRIDGE carries batch trucks, operating on subgrade, over subgrading machine on Mississippi road-building project in Delta country near Shelby.

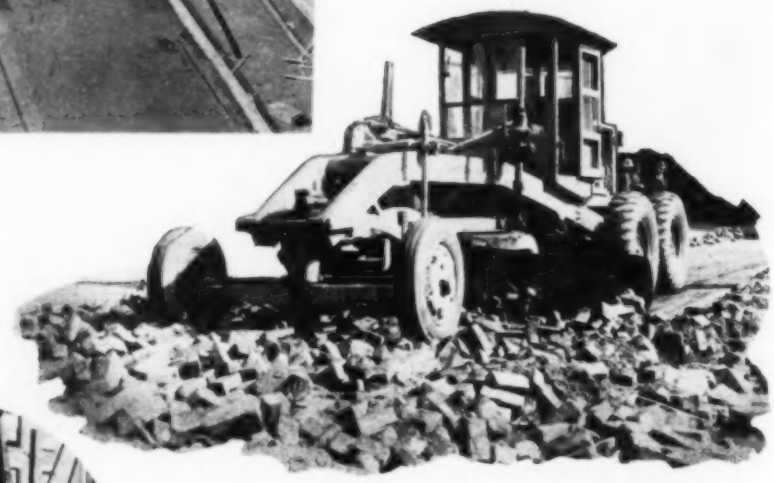
Business Street Resurfaced With Concrete

By N. A. CARLE
City Engineer, Seattle, Wash.



PAVING OPERATIONS in full swing, showing placing and spreading, rolling, tamping, floating, edging and installation of longitudinal dummy joints. Completed pavement in foreground.

POWER SHOVEL having dipper equipped with special long teeth (inset) loads old brick into trucks for hauling to city storage yard.



AUTO-PATROL blade grader windrows brick of old pavement for removal by power shovel.

COMPLETED PAVEMENT, with traffic and parking lanes defined by longitudinal dummy joints and white traffic line at center of street.

SEATTLE has an enviable record in the use of concrete resurfacing on main downtown retail business streets, dating back to the resurfacing of Union St. in 1923. Other concrete resurface jobs on main business streets were Third Ave. in 1928, Pike St. in 1930, and Fourth Ave. in 1932. The most recent concrete resurfacing job is a ten-block section on Fourth Ave., from Washington to Seneca Sts. Contractor N. Fiorito was awarded the contract on Feb. 23, 1937, and completed the job on May 15, at a cost of $40,-811.50; estimated cost was $48,-817.75. The project was financed by city gas tax money and a PWA 45-per cent grant.

The old surface was 50 ft. wide between curbs and consisted of vitrified paving bricks on a sand cushion. The street contained a double-track street car line with brick surface. Buses having been substituted for street cars on this particular route.

PLACING CONCRETE at intersection. Center portion shows old base and background shows completed half of pavement opened to traffic but not washed

WOOD FORM for pavement slab is braced to block nailed to street railway wood ties, which are left in place

the rails were removed and the entire street was resurfaced with concrete.

Pavement was placed in two operations, with a cold joint in the center. By using longitudinal dummy joints, the pavement surface was divided into four traffic lanes of 9-ft. widths and 7-ft. parking lanes. A white traffic line was constructed down the center of the street to divide traffic. High-early-strength cement was used, 1.42 bbl. to the cubic yard. Minimum thickness was 6 in. Although ready-mixed concrete usually is used on such projects, in this instance the contractor elected to use a mixer. Curing was by water and straw.

The contractor dislodged the old paving brick with a Kochring power shovel whose bucket had been equipped with long, specially designed teeth. The shovel dislodged the bricks, windrowed them and then loaded them into trucks. The old sand cushion was windrowed by an auto-patrol grader and loaded into trucks by the shovel. Such sand as remained on the old, uneven concrete base was flushed off with a fire hose. No attempt was made to obtain or prevent bond with the old base.

The same placement of joints was used on the resurface job as on original paving, ignoring cracks or joints in the old base. Dowelled-through ¾-in. transverse joints were placed 60 ft. apart, with transverse dummy joints at 15-ft. intervals.

Costs for this project were nominal, considering difficulties incident to reconstruction of a main business street. Bid prices were $9.50 per cubic yard of pavement in place, including joint material and curing; 30c. per square yard for removing old brick surface and sand cushion (including hauling); 50c. per linear foot for integral concrete curb; and 20c. per linear foot for white cement traffic lines in place.

Bituminous Macadam in Oregon

By R. H. BALDOCK,
State Highway Engineer of Oregon, Salem, Ore.

TEXTURE of surface of Oregon's bituminous macadam non-skid pavement showing presence of ½ and ¼-in. stone

THE SUCCESS of the Oregon State Highway Department in the building of bituminous macadam surfaces is due fundamentally to adherence to the following basic principles: (1) Proper drainage. (2) Adequate foundations. (3) Presence of voids in the bottom of the bituminous macadam stone. (4) Good workmanship.

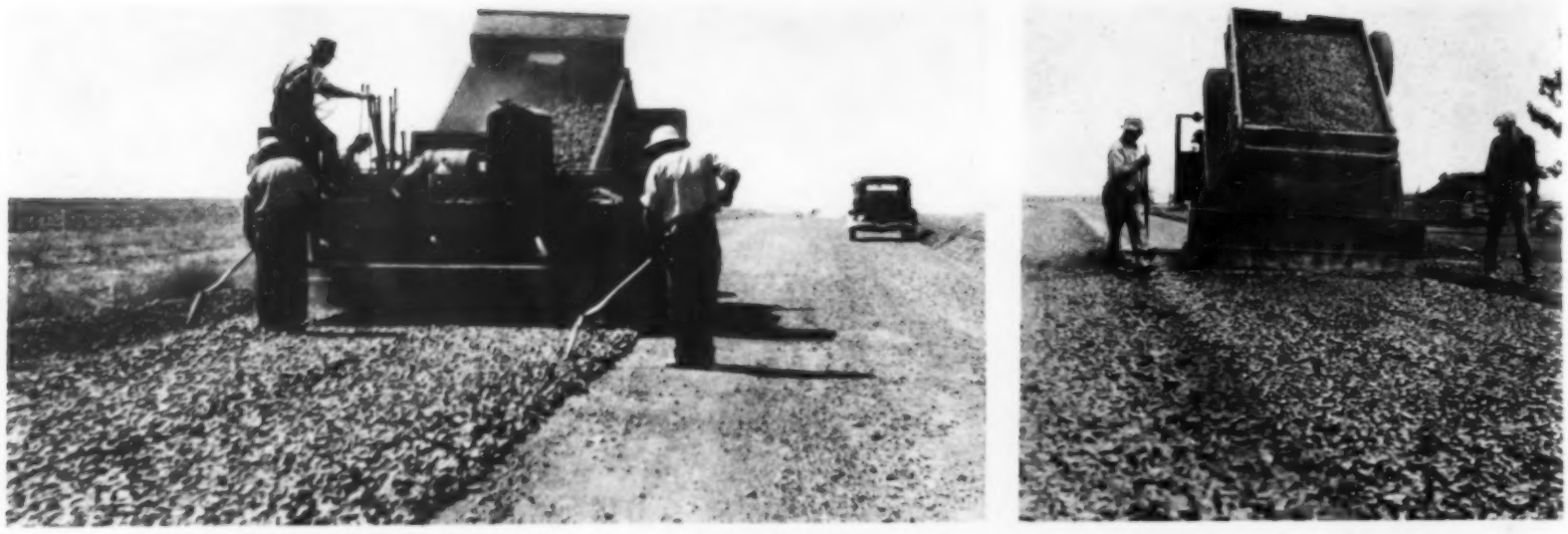
The drainage is properly cared for by means of open ditches, underdrains and the method of construction of the ballast or foundation course.

The bituminous macadam pavement is a flexible type and is recognized as constituting the wearing course—not the base course. The standard practice in Oregon in the building of bituminous pavements consists in the placing of a foundation or ballast course of gravel over the entire width of the roadway from ditch or shoulder, to a depth of approximately 12 in. If possible, a naturally sandy gravel is used; otherwise, the gravel is filled with sand. The use of clay is not permitted.

Upon this foundation a chock stone macadam 4½ in. in depth is constructed. This macadam is built of coarse broken stone, ranging from 4½ to 2½ in. in size. It is filled with ¼-in. (minus) material. The subgrade is slightly crowned under the ballast course and the ballast course is manipulated until it is quite smooth. Likewise, great care is exercised in smoothing the macadam base course.

The secret of success in obtaining smooth pavements rests in the building of the grade, the ballast and the base courses, as well as the wearing course itself, to proper grade and cross-section. For the most part this work is done by machines. Machines will do the work much cheaper and much better than similar work can be performed by hand.

Upon the base course, constructed as outlined above, is then built the bituminous macadam wearing surface. Probably the most uniform non-skid texture pavement laid in the state of Oregon is the penetration



TWO METHODS of spreading stone for base using **(left)** power spreader and **(right)** box on end of truck.

macadam type. The base stone is a 2½-1¼-in. size which is penetrated by hot asphaltic cement and covered with a spread of stone ranging from 1¼ to ¾ in. This stone is carefully leveled by long-wheel-base motor-graders. After the second application of asphaltic cement, the bituminous macadam is keyed with a keystone ranging from ¾ to ½ in. This is followed by the first seal coat using ½-, ¼-in. and ¼-in. (minus) cover stone.

Traffic is turned on to the pavement four or five days before the application of the second seal, after which the surface is thoroughly swept and a second seal, employing the same sized aggregate, is placed. This method effectively seals the penetration macadam against the admission of moisture. Asphaltic cement of 120-150 penetration, heated to a temperature of 425 deg. F., is used in all cases, with the exception of the last seal coat. A water-soap solution, equalling 10 per cent of the hot asphalt by volume, is added through separate openings in the spray nozzles. The temporary emulsion formed covers the stone thoroughly. Either cutback asphalt or emulsified asphalt is used on the second seal.

PRESSURE DISTRIBUTOR applies first penetration of hot asphalt at rate of 1.05 gal. per square yard.

The surface texture of this type of pavement is somewhat coarser than a sandpaper finish, the ½-in. stone and some of the ¼-in. stone being present in the surface. The voids in the base stone act as a reservoir to absorb excess asphalt in hot weather, with the result that this type of pavement seldom bleeds and retains a uniform texture.

In all, 2 gal. per square yard of bituminous cement, including the cutback or emulsion, are required. The total aggregate used equals 0.111 cu.yd. per square yard. Each course of the pavement is thoroughly rolled with 10-ton three-wheeled rollers.

Coincident with the construction of the wearing surface, the shoulders are built up with crushed rock or gravel so as to afford lateral support to the pavement. It will be noted that this type of construction avoids the formation of a reservoir of water under the pavement such as may result from the trench method. The water drains perfectly to the shoulders and then to the ditches.

Oregon has had about 10 years' experience with this type of surfacing. The cost of this construction, starting with the grade, ranges from $10,000 to $20,000 per mile, depending upon the width of the surface, the location and character of the stone and gravel, and the weather conditions at the time the pavement is built.

EQUIPMENT employed on first spread of stone for bituminous macadam construction.

COMPLETED SURFACE of bituminous macadam, with gravel or crushed stone shoulders furnishing lateral support for pavement.

Minnesota Builds Divided-Lane Super-Highway

CONSTRUCTION is well under way on the largest single road construction job in the history of Minnesota's state highway department and by Sept. 15, 1938, the state's most dangerous traffic "bottleneck," which has harried motorists, will be replaced by a divided turnpike of two 24-ft. lanes, each carrying one-way traffic. The road is the super-highway traversing the 11.6 mi. between Elk River and Anoka, the latter 25 mi. northwest from the heart of the Twin Cities. The project is being constructed jointly by McCree & Co. and Phillippi Brothers, both of St. Paul, who were awarded the contract on a bid of $456,128.06. Construction got under way Oct. 4.

PULVERIZER fed by power shovel prepares clay binder for stabilization of subgrade.

GRADED SECTION of new leg of divided-lane highway being constructed on right-of-way 250 ft. wide.

The new highway is part of the Minnesota highway program instigated by N. W. Elsberg, State Highway Commissioner, for the building of roads which will comfortably carry the modern traffic flow and which will embody every precaution for motoring safety. Over the present narrow 18-ft. concrete pavement between Anoka and Elk River, is carried the traffic from three trunk highway routes running to the northwest.

The new divided-lane highway is being constructed on a right-of-way which averages 250 ft. in width. The safety island between the two paved strips will vary from 20 to 90 ft. in width. The island will be depressed to an average depth of 2½ ft. below the road surface. It will be landscaped, particular care being taken not to obstruct vision.

The present 18-ft. concrete pavement, which will be the east lane of the new road, will be widened to 24 ft., with its present line being relocated in four places to reduce curves. The new leg, paralleling on the west of the existing lane, also will be 24 ft. wide and will run on the east bank of the Mississippi.

The entire road runs through rather flat country and the fills will be few, the deepest 15 ft.; the average fill will be 2.4 ft. The nature of both top and sub-soil is sandy loam.

Throughout, the profiles of both traffic lanes will largely be of the same elevation. No curve on the 11.6-mi. stretch will be greater than 5 deg. The back slopes and the shoulder slopes will be constructed on a minimum of 1 on 5.

The inside shoulders of the two lanes will be 4 ft. wide and will be rolled. The outside shoulders, also rolled, will be 10 ft. wide. The back slopes will conform with the natural contours of the land. The shoulders throughout will be built of top soil saved from the stripping.

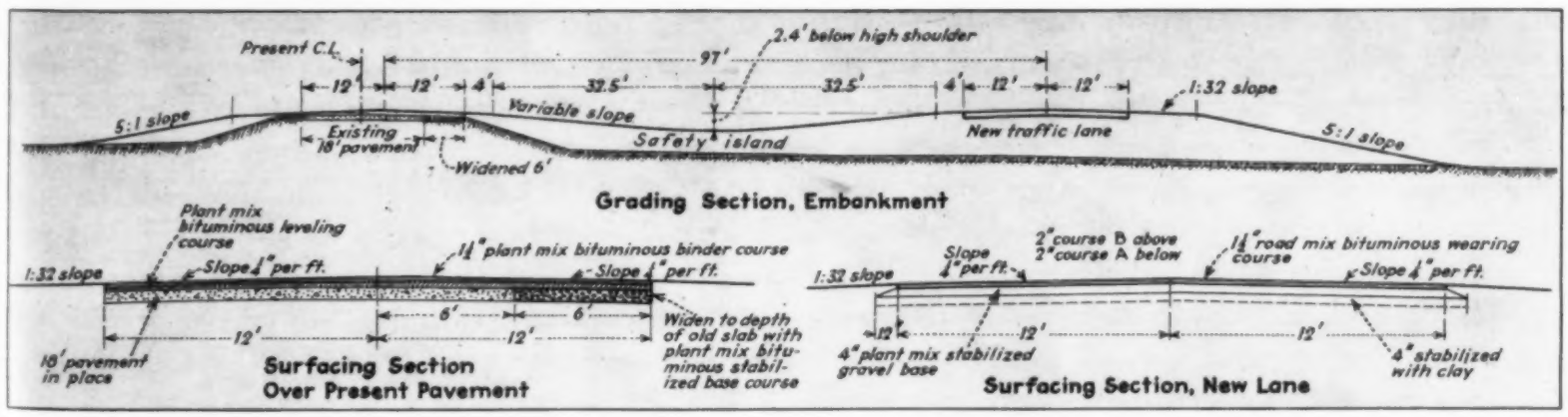
In widening the existing pavement, 3 ft. on each side will be excavated to the depth of the present concrete. This excavation will be filled with plant-mix bituminous base flush with the surface of the concrete. Over the old pavement and the plant mix bituminous strips will go a plant-mix bituminous wearing course, averaging 1½ in. in thickness.

Where the present pavement line is abandoned the new road will consist of a stabilized sub-grade course of 45.7 lb. of clay binder per square yard to be topped off with 4 in. of sand and a stabilized gravel base course consisting of 75 per cent gravel, 15 per cent fine sand, and 10 per cent of binder soil. This base will be topped with a bituminous leveling course of a minimum of 1½ in. and a plant-mix bituminous wearing course of a minimum 1½ in.

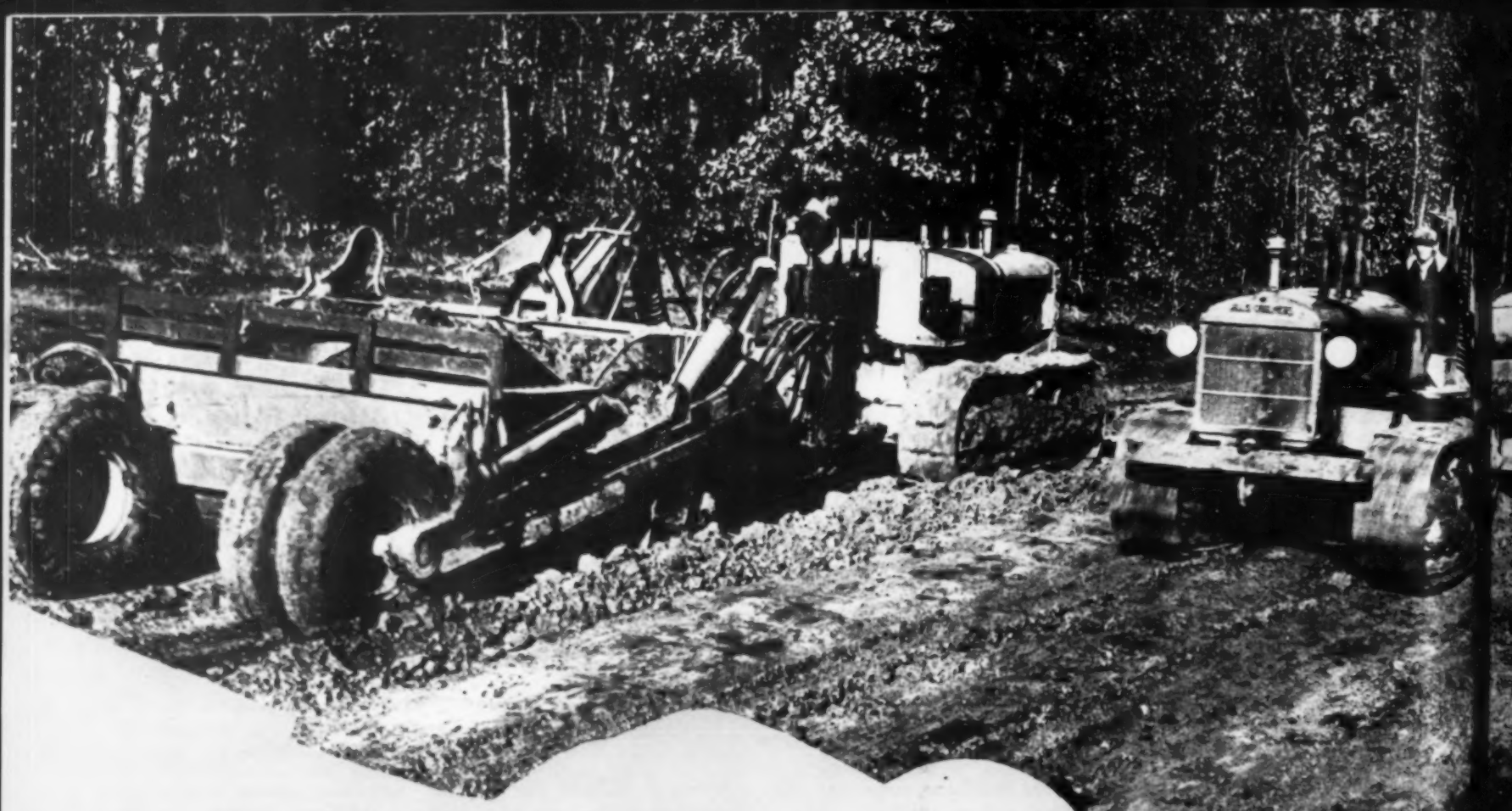
The new leg will be built on a stabilized subgrade course of clay binder in the proportion of 45.7 lb. per square yard and a 4-in. layer of sand, a 4-in. plant-mix stabilized gravel base course consisting of a 2-in. course of gravel, sand and clay binder, and a top 2-in. course of gravel, sand and clay binder with calcium chloride added in the proportion of 9⅛ lb. per ton of aggregate. The new road's surface will consist of a 1½-in. layer of road-mix bituminous concrete wearing course.

The State Highway Department placed T. C. Fahey as engineer in charge of the project, and he will be assisted by a state staff varying from 8 to 20 men during the construction period. The contracting firms are doing their work with the most modern machinery. The grading is being done by two scrapers, one a 9-yd. unit pulled by one tractor, and one a 12-yd.³ outfit pulled by two tractors. Fills are placed in compacted layers of 6 in. by the use of a motor patrol blade grader and a sheepsfoot roller.

Traffic will not be re-routed or disturbed during the construction period, as the existing lane will be used until the new lane is completed. Then traffic will be shifted to the new lane and the work of reconstructing and widening the old lane will progress. Weather conditions this winter will cause temporary halts in construction but the grade for the new lane was completed before real cold set in.



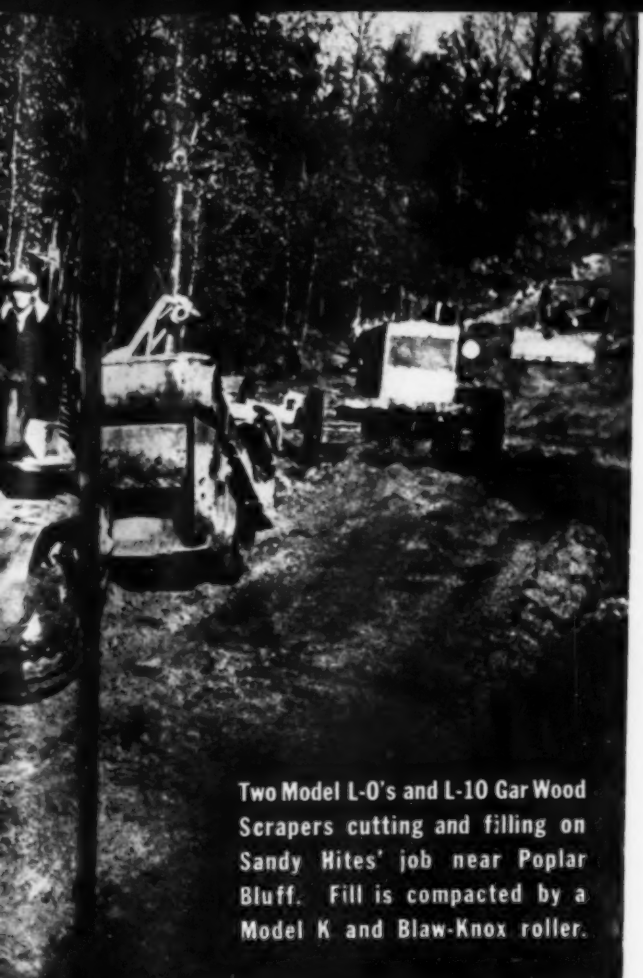
TYPICAL cross-sections of Minnesota's divided-lane superhighway, with depressed safety island varying in width from 20 to 90-ft



SHIFT YOUR JOB *into High* WITH..

Rocky and tough is the clay on Sandy Hites Construction Company's highway relocation job near Poplar Bluff, Missouri, but not too rocky nor too tough for the **FASTER POWER** of Allis-Chalmers tractors. Six A-C tractors are working on this project. They keep it going in *high* from start to finish. They start instantly and go right to work—no fussing with or waiting on auxiliary motors. They move faster because they have more and higher speeds—that means greater flexibility and the right speed for every task. A-C tractor design eliminates speed-robbing deadweight—extra payload is gained by saving tractor weight. Finally, they have ample reserve power for lugging in tough going at low speeds, plus **FASTER POWER** in those higher speeds at which you do 90% of your work—watch that Faster Power gain extra trips hourly over ordinary, slower-moving tractors. It's that Faster Power which enables A-C tractors to maneuver easily and quickly in tight spots, to climb steep grades faster, to move big yardages in a hurry, to cut earthmoving costs. Shift your job into high with this **FASTER POWER**. Ask your nearest A-C dealer for the facts.

LET'S GO! ROAD SHOW. JAN. 17-21, CLEVELAND, OHIO



Two Model L-O's and L-10 Gar Wood Scrapers cutting and filling on Sandy Hites' job near Poplar Bluff. Fill is compacted by a Model K and Blaw-Knox roller.

MORE FOR YOUR MONEY FROM *Faster Power*

When you buy A-C tractors you get more usable power for your money because there is no excess weight to use up power or to figure into the cost. As a result the first cost of **FASTER POWER** is lower than that of ordinary tractors. You get more work from your fuel and lubricating dollar, too, because A-C Controlled Ignition Oil Tractors develop a full, even flow of power on *any clean Diesel fuel or furnace oil* — no extra-cost, premium fuels or special lubricants are required. Lower fuel costs, lower first cost, **FASTER POWER**—from these you get lower-cost yardages, consequently *more profit.*

ASTER POWER

...re highway shoulders are broadened in a hurry as the A-C Model K and 5-yard Contin...ental Scraper (one of two such outfits on this job) end-dump over the edge of the fill.

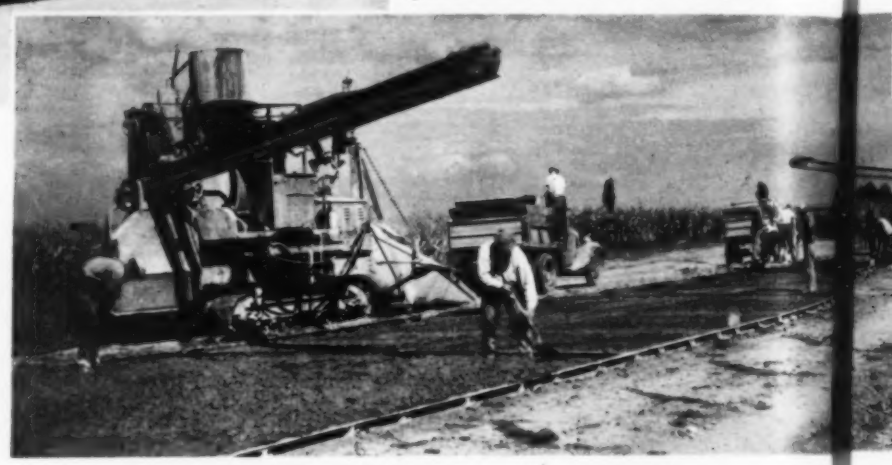
This Model K does clean...ddy by stalling with ...Baker Bulldozer and roll...ing the spread material with a Blaw-Knox roller.

ALLIS-CHALMERS

TRACTOR DIVISION—MILWAUKEE, U. S. A.

Controlled Ignition OIL TRACTORS

Indiana Double-Tracks 14 Miles of *Lincoln Highway*



TWO 27E PAVING MIXERS operating boom-to-boom outside road forms on same shoulder of one 22-ft. concrete roadway produce up to 804 batches in 8 hr. for Thomas McQueen, under 60-sec. mixing specification.

RELOCATED SECTION (left) of Lincoln Highway runs 14 mi. east from Schererville toward Valparaiso. Route 55 is scene of Thomas McQueen's subsequent contract.

AFTER COMPLETING CONTRACT on U. S. 30, Thomas McQueen's two pavers move to intersecting job on State Road 55, where mixers operate on opposite shoulders (11 ft. wide) of 20-ft. slab, and place up to 1,800 lin.ft. of 9-6-9-in. cross-section in 8 hr.

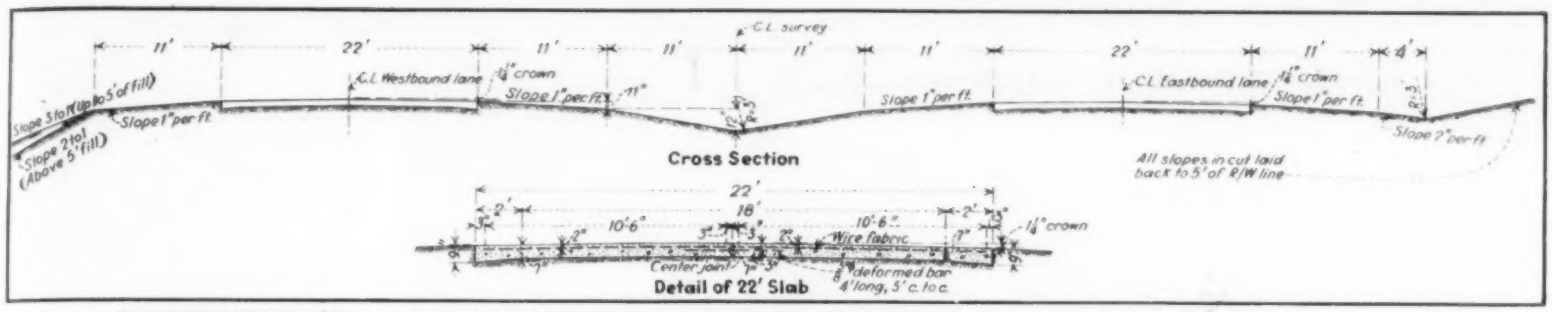
TAKING A RIGHT-OF-WAY 200 ft. wide and building two 22-ft. concrete roadways separated by a 44-ft. center strip, the Indiana Highway Commission in the last 2 years has completed 14 mi. of modern high-speed highway for heavy traffic volume on U. S. 30, extending eastward from an intersection with U. S. 41 toward Valparaiso, Ind. During the last summer and fall, three contractors, Thomas McQueen, of Forest Park, Ill., the A. C. Proudfoot Construction Co., of Hammond, Ind., and the Bontrager Construction Co., of Elkhart, Ind., placed the concrete pavement and finished the shoulders on this highway project. Boom-to-boom operation of two pavers by Thomas McQueen, long truck haulage of boxed batches by A. C. Proudfoot, and mechanical subgrade trimming by J. C. Bontrager were features of the construction work. On the Proudfoot contract, the State Highway Commission inaugurated a study of subgrade stabilization by treating seven consecutive 2,500-ft. sections of base on the eastbound lane, applying a different treatment to each section and leaving the parallel westbound roadway untreated to provide a comparison of results.

Backslopes and Drainage—Relocated to practically railroad alignment, reducing curvature and grades to a minimum, the broad right-of-way for the new boulevard, crossing the rolling, open country of northwest Indiana, offered an exceptional opportunity for spacious treatment of the grading section. The engineers in charge of the project in the field took full advantage of the opportunity thus offered, laying back all cut slopes to within 5 ft. of the right-of-way line. This improvement in design flattened the slopes in cuts, which are relatively shallow, to anything from 1 on 3 to 1 on 8, as compared with the conventional Indiana standard of 1 on 2 up to 6 ft. of cut and 1 on 1½ above 6 ft. of cut.

In addition to the normal drainage system, the engineers called for the installation of transverse subgrade drains of perforated bituminous-coated corrugated 6-in. metal pipe at the low points of all vertical curves and at about 200-ft. intervals under sand-fill base (placed on one of the experimental stabilization sections). The perforated transverse pipe drains, laid in trenches about 18 in. deep and 12 in. wide, backfilled with broken stone, already have proved their value by the amount of water which they take away from the subgrade.

SLOPES LAID BACK to 5 ft. of property line on 200-ft. right-of-way give unusually spacious appearance to double-track boulevard designed with 44 ft. of grassed parkway between two 22-ft. concrete roadways. Slopes are harrowed by contractors for later grass seeding by Indiana Highway Commission.

Subgrade Treatments — Subgrade soil on the improvement is principally clay or sandy clay—a type of material which has given trouble under other concrete slabs laid in this part of Indiana. On the Dunes Relief Highway, for example, constructed mainly on sand subgrade near Lake Michigan (CONSTRUCTION METHODS, *June, 1932, pp. 32-35*), the concrete slab resting on sand is in practically as good condition today as when laid 6 years ago, but the portion placed on clay squirts mud at the joints each spring. In an effort to find an economical means of combatting this condition, the Highway Commission is experimenting with the seven base treatments, each 2,500 ft. long, on the Proudfoot job. Three of the sections received bituminous treatments at the rate of 1½ gal. per



ON RIGHT-OF-WAY 200 ft. wide Indiana Highway Commission builds divided-lane highway having two 22-ft. concrete pavements with 66-ft. distance between their center lines. Field engineers lay cut slopes back to 5 ft. of right-of-way line.

square yard or less, applied and mixed with the soil to a compacted depth of 3 in. Of these three sections, one received 10,000 gal. of medium curing asphalt at a cost of $2,000, a second received 9,000 gal. of emulsified asphalt at a cost of $1,800, and the third received 8,000 gal. of tar at a cost of $1,760.

Another group of three sections was given subgrade treatment using sand fill, stone dust or stone and stone dust. Sand backfill to the amount of 1,111 cu.yd. was placed on one section to a compacted depth of 6 in. for $1,111. To another section, after scarifying, the contractor added 417 tons of limestone dust, mixed the combined materials and rolled to a compacted depth of 3 in. for a total price of $1,042.50. On the third section of this group, 556 cu.yd. of stable mixture of crushed limestone and stone dust was placed and compacted to 3-in. depth for $1,112.

As a final experiment, on the seventh section, Indiana tried the water saturated subgrade treatment which, according to report, has had some success in Kansas. This process consisted of ponding water on the scarified subgrade and later rolling the saturated material, as it dried out, at its optimum moisture content to obtain maximum density. The desired moisture content was determined by the state highway testing laboratory. This section was built and compacted by the contractor at a unit bid price of 27c. per linear foot, or $675 for the section.

Drilled cores are to be removed from the slab and subgrade of the various experimental sections next spring, and the Commission plans to run precise levels on the surface, especially at the joints, four times each year for the next few years.

Pavement Design — On the prepared subgrade, whether treated or untreated, the paving contractors placed reinforced-concrete slab 22 ft. wide of 9-7-9-in. cross-section, the 9-in. thickened edge reducing by straight taper in 2 ft. to uniform 7-in. thickness across the central 18-ft. portion of the slab. Transverse expansion joints ½ in. thick were installed at 40-ft. intervals, and the slab was divided longitudinally by a center-line joint installed in the concrete. Expansion joints incorporated load transmission devices of two types, and the center-line joint was formed either by metal plate or by a 2-in. by ¼-in. bituminous strip inserted vertically through the surface. In either case, the longitudinal center-line joint was doweled with transverse ⅜-in. deformed steel bars. Welded wire mesh reinforcement was placed 2 in. below the surface.

Construction Requirements— Specifications called for two sizes of crushed stone or gravel in the concrete mixture, designed with a cement content of six sacks per cubic yard. All ingredients except water were weighed. A 10-per cent overrun was permitted in the 27E pavers used by all three contractors, and batches were proportioned to produce 29.7 cu.ft. of concrete containing 620 lb. of cement. As required by specifications, the mixers were equipped with time locks to assure full 1-min. mixing after all dry materials had been admitted to the drum. Large aggregate included sizes of stone or gravel ranging from 2 in. to ½ in., and intermediate aggregate included sizes from 1 in. to particles retained on the No. 8 sieve.

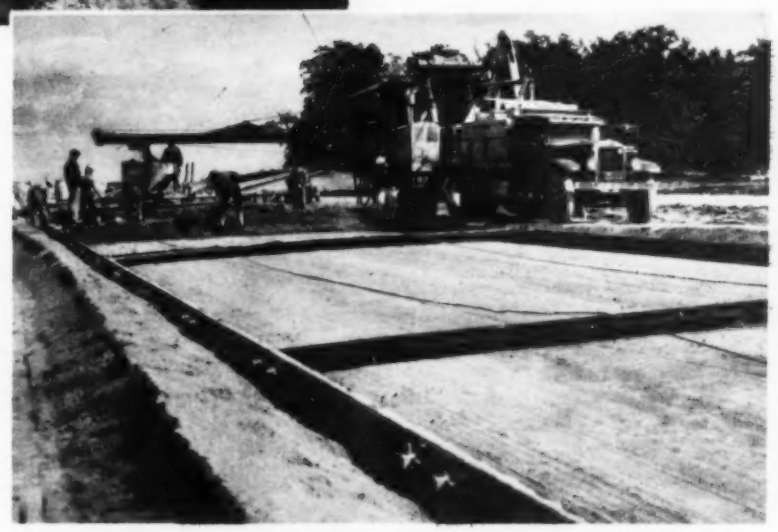
As an economy measure, all the contractors used bulk cement delivered to railroad track hoppers by hopper-bottom cement cars. Bulk-cement plants handled the material from the track hoppers and weighed it for loading into the batch trucks. Specifications required that the contractors provide separate compartments for cement both on batch trucks and in batch boxes.

Mixers were directed to operate outside the forms on the 11-ft. shoulders, ample in width for this purpose. Grading of the project had been completed the previous year, and the subgrade and shoulders were in good condition to carry construction equipment. Concrete was placed in two layers, the first layer being struck off 2 in. below finished grade to permit steel setters to place the reinforcing mesh before the second layer of concrete was spread on top of it.

After the top layer of concrete had been placed on both sides of an expansion joint, the joint was vibrated by a high-frequency vibrator mounted on a sled which was drawn across the slab, straddling the joint, as indicated by a photograph. Vibration by this method has given good results on other concrete paving jobs in Indiana, where joints broken open after construction have shown satisfactory consolidation and freedom from honeycomb.

Finishing machines made three passes over the surface and belted the concrete on the final pass. A longitudinal float was required behind the finisher. The pavement was broomed and was cured with wet burlap for 24 hr., followed by wet straw spread to 3 in. compacted

BATCH BOXES hauled 17 mi. by truck trailers and handled into mixer skip by crawler crane supply dry materials to 27E paver on Proudfoot job.



CONVENTIONAL DELIVERY of dry materials by multi-batch trucks to mixer skip is procedure followed on Bontrager contract.

BROAD CENTER DITCH. 22 ft. wide between 11-ft. shoulders, slopes to bottom grade only 23 in. below edge of concrete pavement. Drainage is trapped into catch basins with cast-iron covers. Contracts call for sodding of ditches.

LOADING BATCHES (below) at 28-sec. intervals during periods of maximum production, materials-handling plant is equipped with two aggregate weight-batching units, two cranes for charging bins out of track hoppers and (concealed in background) unloading, storing and metering equipment for bulk cement.

depth and kept wet for 7 days. Slab was thrown open to traffic at not less than 7 days when beam breaks developed a modulus of rupture of 550 lb. per square inch. Contractors used tank-truck distributors equipped with swivel spray bars extending from the sides to keep the straw wet during the curing period. Specifications set 2½ in. as the minimum size pipe for water lines, but Thomas McQueen purchased 6½ mi. of new 3-in. pipe to supply his two pavers.

McQueen Contract—Providing for the paving and finishing of 7¼ mi. of highway at the east end of the improvement, the Thomas McQueen contract involved the largest quantities of the three jobs. Concrete pavement in this contract amounted to 190,000 sq.yd., and the total value of the contract was almost $400,000. Slab was bid at $1.70 per square yard and joints at 50c. per foot. The latter item totaled about $21,000, while shoulder finishing amounted to about $24,000.

Two Pavers—To expedite construction of concrete slab in two layers on this contract, Thomas McQueen made use of a two-paver team operating boom-to-boom on the same side of the roadway. A similar arrangement had been utilized in other states where contractors were required to strike off a bottom layer of concrete to support reinforcing steel (notably on Long Island, N. Y., as described in CONSTRUCTION METHODS, *June, 1934, pp. 48-50*), but so far as is known no other paving outfit ever made progress records equaling those attained on this Indiana contract. A uniform concrete mixture was used in the two courses of the slab.

Operating in strongly unionized territory, all contractors on the Lincoln Highway improvement worked an 8-hr. day. With its two pavers functioning in boom-to-boom arrangement on the same shoulder of each roadway, the Thomas McQueen crew placed 190,000 sq.yd. of concrete pavement in the two roadways of its 7¼-mi. contract in 59 working days, on some of which the pavers ran 2 hr. or less because of wet weather. On the second 22-ft. roadway, the two mixers completed the 7¼-mi. of paving in 23 working days. In the two consecutive best weeks on the job, the pavers averaged 1,605 lin.ft. per day the first week and 1,608 lin.ft. per day the second week. On their best single day, the two machines placed 1,729 lin.ft. of 22-ft. pavement in 8 hr., mixing 804 batches in this time.

As its part of the paving operation, the first mixer placed batches for the bottom layer exclusively and pulled forward the heavy steel strike-off, riding on the steel road forms, by a power winch. The second paver placed all of the 2-in. top-course concrete and, in addition, filled occasional gaps of bare subgrade left by the first mixer. By leaving short sections of 5-in. bottom course to be filled by the second paver, the contractor increased the output of this unit and brought it up to a more nearly equal production level with the forward mixer.

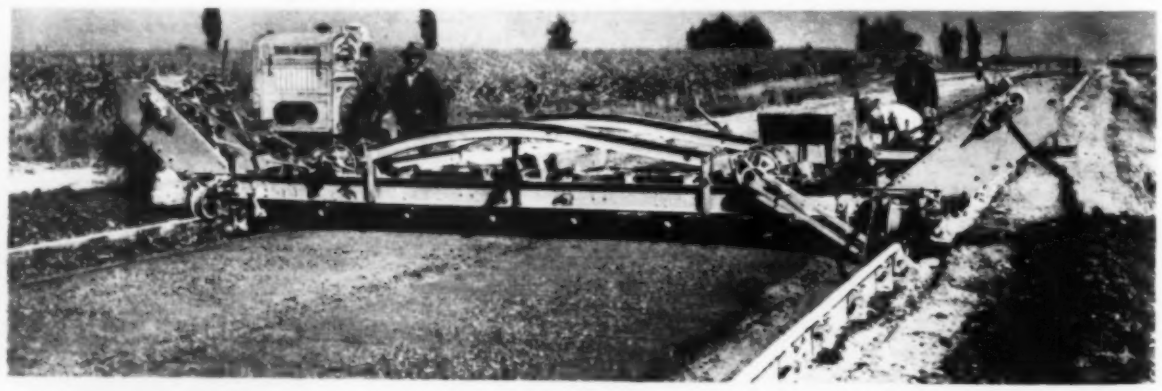
Water Supply—Water for the entire paving job was taken from a stream near the east end of the contract and was pumped a maximum distance of 6½ mi. through 3-in. pipe. To maintain an adequate supply for mixing and curing the concrete, the contractor installed a Gorman-Rupp R125 special triplex pump which delivered 135 g.p.m. at the mixers, 6½ mi. from the source, with a pressure of 550 lb. per square inch, or greater, at the pump and 60 to 80 lb. per square inch at the discharge point.

Finishing Machine—Behind the twin-mixer team, a Blaw-Knox gasoline-electric finishing machine screeded and belted the pavement surface. To provide additional power for the operation of an electric vibrator, used in vibrating expansion joints, the contractor replaced the original 220-watt generator on the finishing machine with a 240-watt unit. In the 40-ft. stretches between expansion joints, the vibrator and its sled mounting were carried on a bracket at one side of the finishing machine.

Batching Plant—Using gravel and torpedo sand such as Thomas McQueen put into the concrete on his contract, a typical batch yielding 29.7 cu.ft. called for 620 lb. of cement, 1,341 lb. of torpedo sand, 1,407 lb. of intermediate size aggregate, and 938 lb. of large aggregate. McQueen's batching plant was set up on a railroad siding near the center of the 7¼-mi. contract and just a few hundred feet from the eastbound roadway. When the job was operating at maximum productivity, the plant weighed out a batch every 28 sec., although this speed never was maintained for a full 8-hr. day.

Aggregates in the three sizes were received in hopper-bottom railroad cars which discharged into track pits. From these pits, a Lorain and a Northwest crane, each equipped with a 50-ft. boom, handled the materials in 1- and ¾-yd. clamshell buckets to reserve stockpiles or overhead bins.

A pair of Blaw-Knox steel overhead bins, one for sand and another with two compartments for the separated sizes of coarse aggregate, fed the materials into batchers where the weights were measured by Winslow scales. An electrically operated Blaw-Knox bulk cement plant unloaded cement into a bin of about 350-bbl. capacity from which the material was



POWER SUBGRADER draws itself forward by winding wire-rope cables on power winches, cutting subgrade to cross-section profile and casting excess earth on shoulders.

drawn off and weighed before being loaded into separate boxes on the batch trucks.

Proudfoot Contract — Adjoining the McQueen job to the west was a 4.46-mi. paving and shoulder-finishing section, calling for 122,500 sq. yd. of concrete pavement, bid in by the A. C. Proudfoot Construction Co. for about $245,000. This contractor utilized an unusual batch supply service, subletting the hauling and handling of 29.7-cu.ft. batches in steel boxes (previously used for industrial railway hauling), transported on flat-body trucks and trailers 17 mi. from a stone quarry and crushing plant across the state line in Illinois. The Red Top Construction Co., subcontractor, Hammond, Ind., operated fourteen to sixteen truck-and-trailer units in this service, hauling five batches per trip, and rented from the general contractor a crawler crane to handle the batch boxes from the trucks into the skip.

On this contract, because the contractor preferred to buy stone-sand and crushed stone for concrete aggregates, the batch weights had to be adjusted to fit the characteristics of these materials. Typical batch weights for a 29.7-cu.ft. batch were: cement, 620 lb.; stone sand, 1,400 lb.; intermediate size crushed rock, 1,312 lb.; large size crushed rock, 873 lb. A Koehring 27E paver, operating on the shoulder, mixed the concrete batches and placed them in the roadway, where they were finished by a gasoline-powered Ord machine. An adequate supply of water was furnished through 2½-in. pipe line by a Novo triplex pump.

Throughout the job, the Proudfoot paving crew averaged 90 lin.ft. of roadway slab per hour. In a good 8-hr. day, the crew placed 748 lin.ft. of 22-ft. roadway.

Two Cement Plants — Although coarse aggregate and stone sand for the Proudfoot job were hauled a long distance from an Illinois quarry, cement was loaded at a more convenient point on a railroad siding in Schererville, near the west end of the contract, by a Butler bulk cement plant. Another bulk-cement plant of similar type set up nearby on the same railroad siding furnished cement to the batch trucks of the Bontrager Construction Co. for the third paving contract at the extreme west end of the improvement.

Bontrager Contract—The Bontrager Construction Co. also used stone-sand for fine aggregate and crushed stone for coarse aggregate, these materials being delivered in bulk by truck to a job batching plant from the same quarry in Illinois which furnished aggregates for the Proudfoot contract. Total value of the Bontrager paving contract was about $125,000, which included a cost of $32,000 for the intersection of U.S. 30 (the Lincoln Highway) and U.S. 41. Length of the paving work on this section was 1.9 mi., and the pavement area aggregated 59,000 sq. yd., of which 13,000 sq.yd. was placed in the intersection. To reduce interference with traffic to a minimum, the engineers called for the use of high-early-strength cement in about 7,000 sq.yd. of intersection pavement.

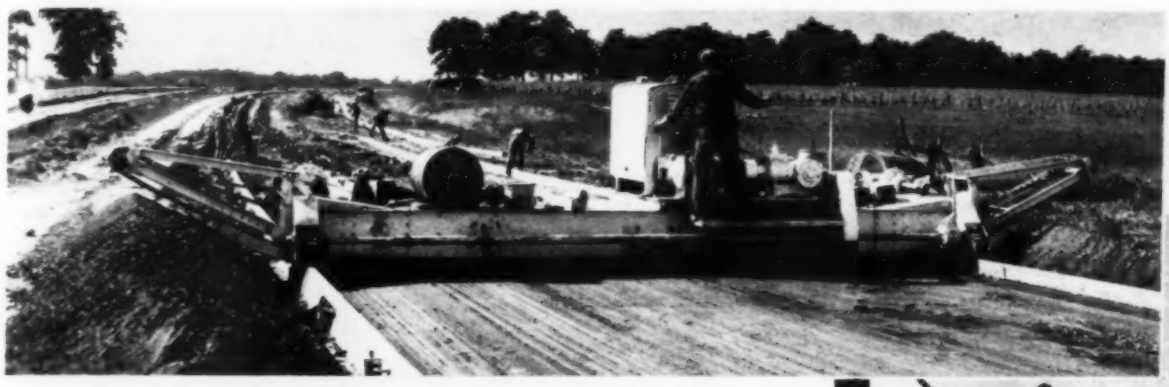
An outstanding feature of the work on this contract was the use of a self-propelled Flynn power subgrader to trim the fine grade to final cross-section profile ahead of the paving crew. So far as could be learned, only two subgrade machines of this type have operated in Indiana, the other unit being used by Burns Bros., of Indianapolis. According to information picked up on the job, the machine whittles the grade to accurate cross-section of uniform density through the action of curved teeth, resembling mattock blades, attached to a rotating hollow shaft of large diameter, which turns at a uniform speed of 135 r.p.m., regardless of the travel speed of the subgrader. The machine has three forward speeds, from 3 ft. to 15 ft. per min., and is propelled by crawler tracks, traveling on the steel road forms.

For a 22-ft. width of subgrade, the rotating hollow shaft is equipped with 130 mattock-like teeth. Each tooth is about 2 in. wide and is turned to put the flat surface parallel with the subgrade when it strikes the lowest point of its circle. Behind the rotating teeth, the machine carries two scraper chains, operating transversely across half widths of the roadway, which pick up the excavated soil and deposit it on the shoulders. To prevent the escape of material behind the scraper chain and to clean up the subgrade to accurate profile, the machine carries a rear subgrade planer adjusted to true crown. The machine pleased the engineers on the job by the minimum of vibration which it imparted to the forms.

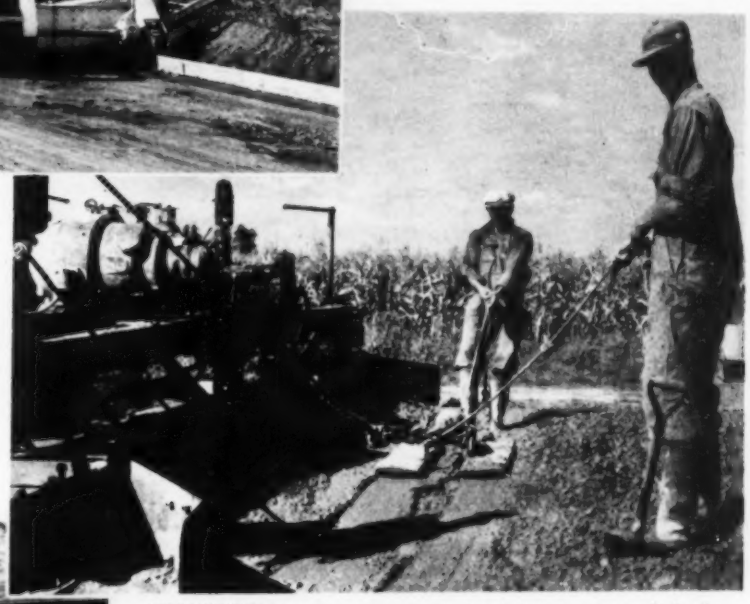
Operating a Rex 27E paving mixer on the shoulder and delivering 29.7-cu.ft. batches to the mixer skip from three-batch trucks, the Bontrager paving outfit placed about 750 lin.ft. of 22-ft. roadway slab in an average 8-hr. day. The pavement was finished by a Lakewood machine.

Administration—For the Indiana State Highway Commission, M. R. Keefe is chief engineer, and Sultan G. Cohen is engineer of construction. The double-tracking of U. S. 30, described in these notes, was carried out under the direction of the LaPorte district office, Oliver Downs, district engineer, and B. E. Phelps, assistant district engineer in charge of construction. All contracts involved in the improvement were executed under the immediate supervision of C. H. Sweeney, supervising engineer, Valparaiso, Ind. The following project engineers were in direct charge of operations on specific contracts: McQueen contract, F. S. Hill; Proudfoot contract, W. M. Sprankle; Bontrager contract, Harold Bowen.

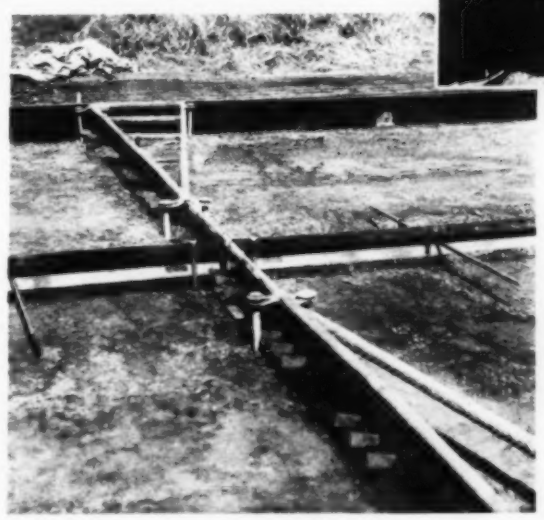
On the paving sections, operations were directed for the contractors by R. D. Harper, superintendent, Thomas McQueen, Forest Park, Ill.; G. S. Smith, superintendent, A. C. Proudfoot Construction Co., Hammond, Ind.; C. E. Moore, superintendent, Bontrager Construction Co., Elkhart, Ind.



HARD, DENSE SUBGRADE, trimmed to accurate cross-section profile, is left by rotating curved teeth of power subgrader which propels itself by traction treads on top of steel road forms.



VIBRATION of transverse expansion joints is accomplished on all contracts by high-frequency vibrators mounted on sled runners which are drawn across slab straddling joints. McQueen's crew uses electric vibrator driven from generator on gasoline-electric finishing machine.



RIGHT-ANGLE TEMPLETS (left) square up and lock in position ½-in. premolded expansion joint filler, incorporating finned load-transmission devices, on Proudfoot contract.

Railway Grade Separations Improved

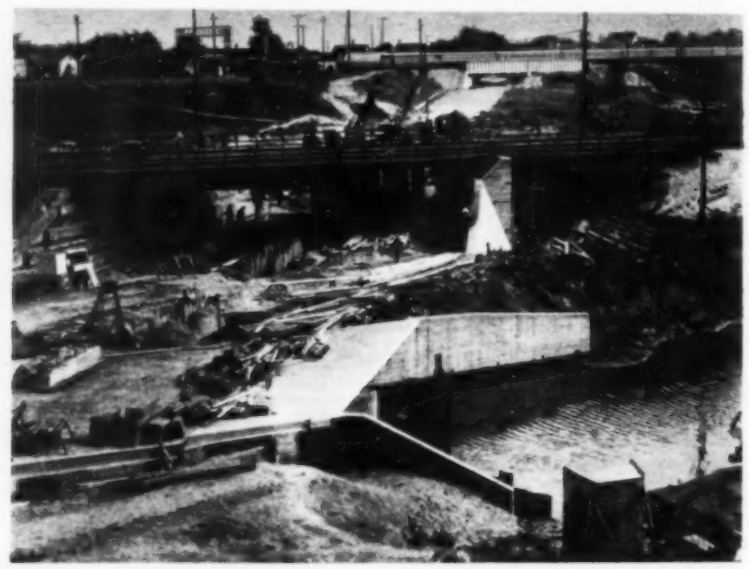
in Milwaukee Area

ABUTMENT FORMS sheathed with five-ply plywood are designed to withstand vertical concrete rise of 5 ft. per hour. Abutment is concreted in three sections. On this day contractor places 80 some yards in final section.

AN $800,000 IMPROVEMENT of South Chase Ave., Milwaukee, Wis., built with the aid of federal funds by the Wisconsin State Highway Commission, has replaced two inadequate and obsolete railroad grade separation bridges with steel girder spans providing ample clearances, has graded and paved 0.705 mi. of divided-lane roadways, each 28 ft. wide, and has provided a new reinforced-concrete girder bridge across the Kinnickinnic River to accommodate the two roadways and their parallel sidewalks. A few miles south of the city, the State Highway Commission in recent months completed another interesting grade separation by which two intersecting roads, Rawson and Howell Aves., meet on a single four-way multiple-steel-girder-span bridge above the tracks of the Chicago, North Shore & Milwaukee high-speed electric line.

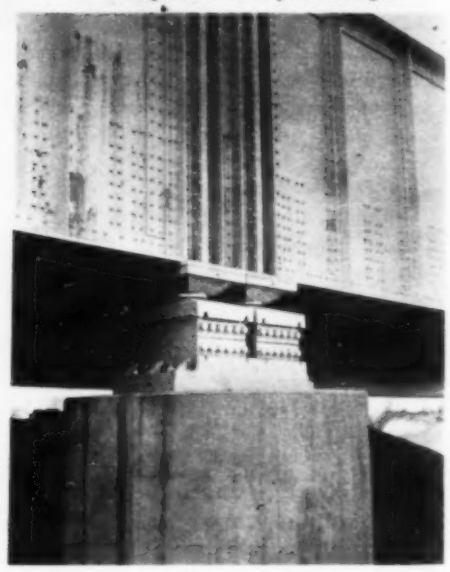
South Chase Ave.—Each of the two railroad bridges crossing South Chase Ave. consists of two spans resting on concrete abutments and a center pier, the latter located in the separating strip between the two roadways. One bridge, carrying two operating tracks of the Chicago, Milwaukee, St. Paul & Pacific Railroad Co., was put under contract by the railroad with the Klug & Smith Engineering Co., Milwaukee, at a bid price of about $148,000. The foundations of this bridge rest on solid material.

Placed on a skew of 50 deg. 22 min., each span of the bridge is car-



THREE BRIDGES replace inadequate and obsolete structures on South Chase Ave. improvement, Milwaukee. In foreground is one of twin decks, separated by 1½-in. opening, carrying divided roadways of new highway across Kinnickinnic River. Just beyond river bridge appear temporary falsework, old stone pier, and old steel girders supporting two operating tracks and one yard track of North Western line while contractor builds abutment and performs other work for one span of new two-span railroad bridge. In background, Milwaukee Road's famed Hiawatha flashes across completed two-span bridge.

STEEL SHEETPILE COFFERDAM for center pier of Kinnickinnic River bridge utilizes standing wall of sheeting around completed north abutment for one side of new coffer. In this way contractor saves pulling and driving one row of sheeting.



MOVABLE BEARINGS (right) on center pier of waukee Road bridge consist of ball and so seats on rocker nests.

STREAMLINED STEAMER (right), Milwaukee Road's fast-flying Hiawatha, speeds between girders of new double-span bridge. Earth bank remains under bridge until grading starts for new roadways.

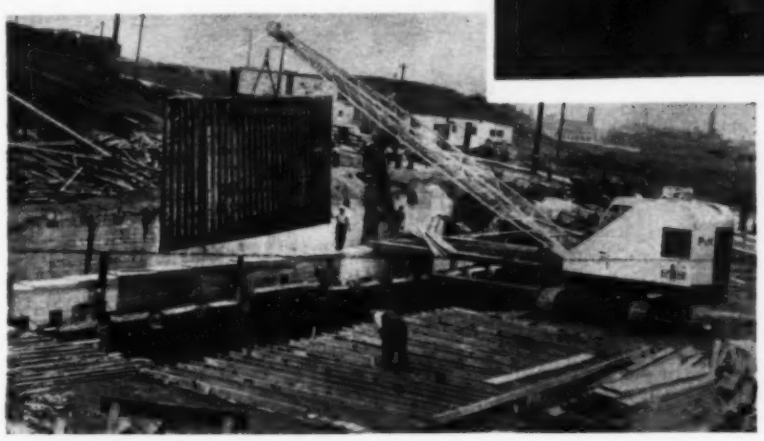
TWO HIGHWAYS intersect on this four-way grade separation bridge, which carries Rawson and Howell Aves. over two tracks of interurban electric railway south of Milwaukee.

FIXED BEARING on abutment of Milwaukee Road bridge also makes use of ball and socket seat. Note rocker plates under ends of cropped steel floor joists resting on bearing member on skewed concrete abutment.

ried by steel plate girders 10 ft. ½ in. deep and 74-ft. long. The square opening under each span, between the abutment and the center pier, is 38 ft., providing space for a 28-ft. roadway and a 10-ft. sidewalk.

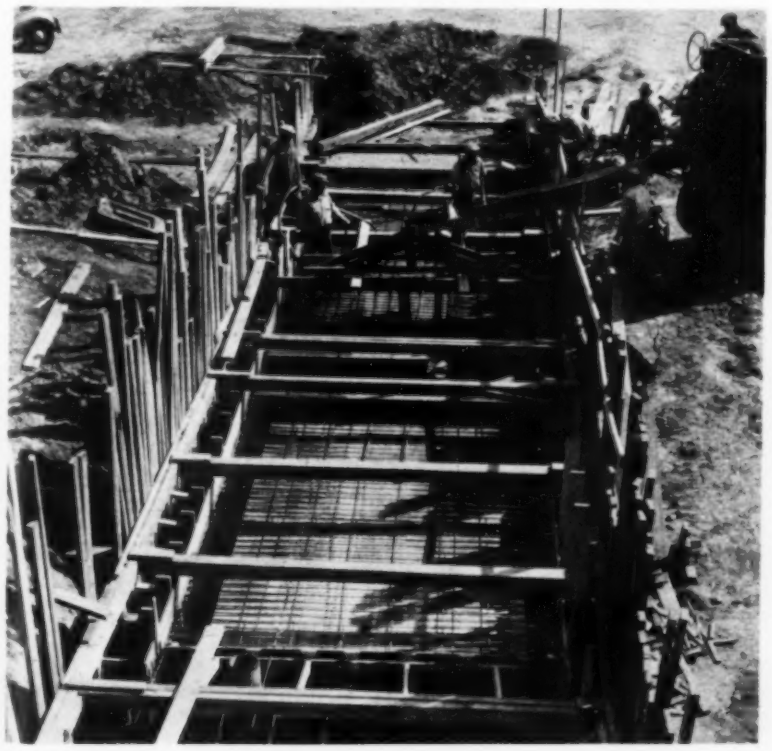
A second railroad bridge is being constructed on the project, at the throat of the Chicago & North Western Railway Co.'s South Chase yards, to carry two running tracks and one yard track across the divided-lane highway. Driven piles support the abutments and center pier. The substructure was built and the structural steel for the superstructure was supplied by the Klug & Smith Engineering Co., under a State Highway Commission contract having a total value of about $195,000, which included also the construction of the river bridge.

Skew angle of the North Western bridge is 27 deg. 9 min. To provide square openings each 38 ft. wide, corresponding with those in the Milwaukee Road bridge, the steel girders are 53 ft. long, measured from center line of end bearings to center line of central bent. The railroad company awarded a contract for temporary trestle work, track work and erection and painting of structural steel to the Colianni & Dire Co., Chicago, Ill., for a bid price of about $183,000.



SAVING TIME in stripping forms from center pier of river bridge, crane lifts panels 18 ft. high and 35 ft. long and places them flat on ground, where two carpenters complete wrecking in one-fourth of time required when similar forms are left in vertical position. Panels previously were shifted and re-used in forming second section of center pier.

River Bridge—The Kinnickinnic River bridge, constructed by the Klug & Smith Engineering Co., under a contract already mentioned, really is made up of two bridges, each 44 ft. 3 in. wide, separated by a narrow open joint parallel with the center lines of the two roadways. Each unit in turn is made up of two 20-ft. clear spans. The bridge, resting on solid foundations, is skewed at an angle of 40 deg. 45 min.



TRUCK-MIXED CONCRETE (left) for walls and roof of 5x10-ft. box sewer is discharged directly through chute to forms. On this day, sixteen 4-yd. truck mixers delivering full-capacity concrete batches, shrunk-mixed at plant prior to loading, have difficulty in supplying needs of job.

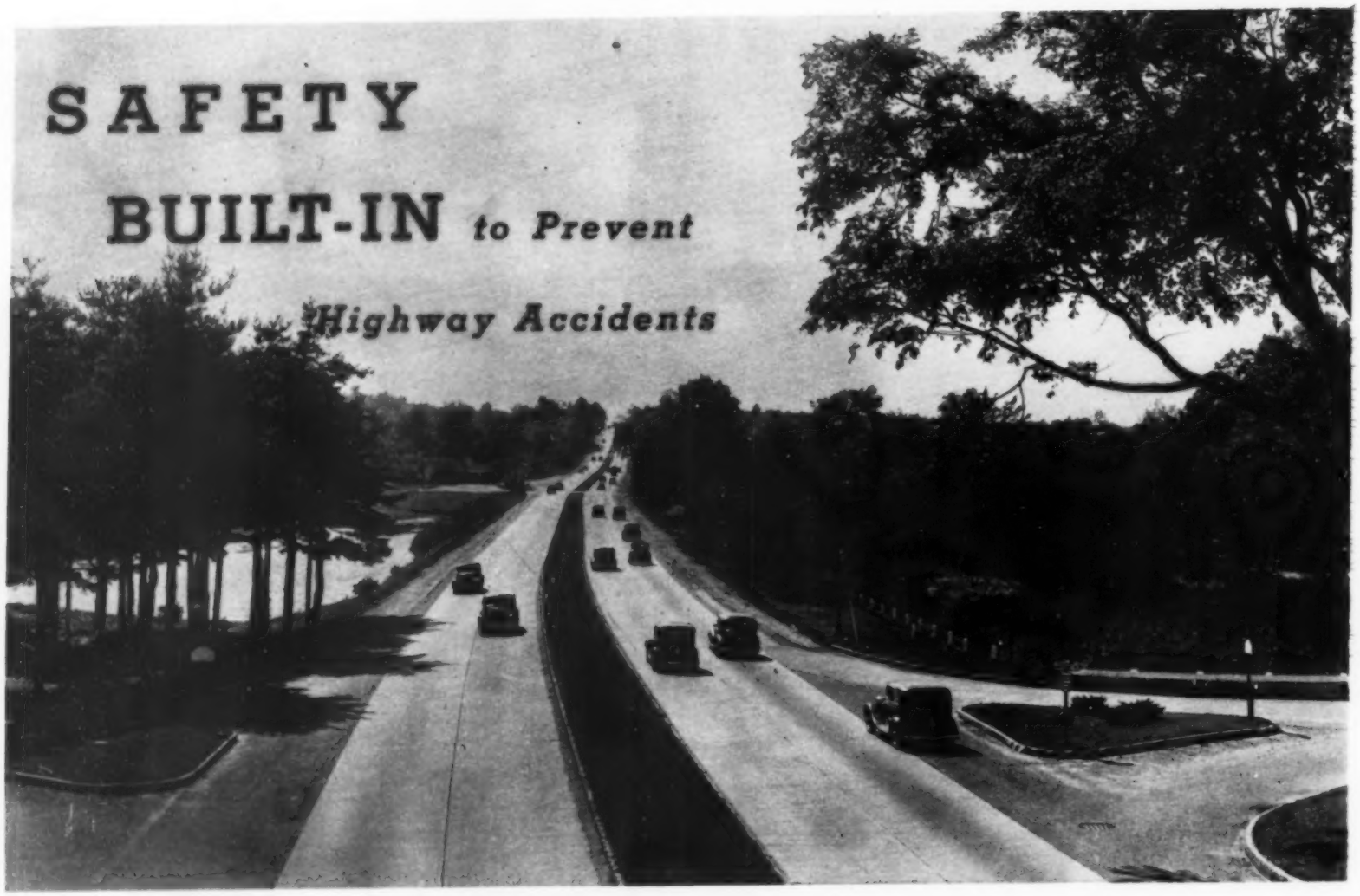
All grading for the South Chase Avenue improvement, including a heavy hillside cut on relocation at the north end of the project, is being done by the Milwaukee General Construction Co., Milwaukee, Wis., under a $167,000 contract let by the State Highway Commission. The contract calls also for placing a uniform 8-in. concrete base for the two 28-ft. roadways and building two 6-ft. by 5-in. concrete sidewalks located at variable distances from the outer roadway curb. Sheet asphalt 3-in. pavement will be placed on the concrete base under separate contract.

Rawson-Howell Separation—Intersecting above two tracks of a fast interurban railroad, the Rawson-Howell multiple-girder grade separation bridge has roadways 36 ft. wide, face to face of curbs. Each roadway is flanked by two 5-ft. sidewalks. The four-way bridge, involving 28,000 lin.ft. of treated timber piling, 1,100,000 lb. of structural steel, 470,000 lb. of reinforcing steel and 3,900 cu.yd. of concrete, was built by the Worden-Allen Co., Milwaukee, Wis., at a contract price of $192,600.

Mud-Jack Sleeves—Grading and paving of the long filled appoaches to the four-way bridge were executed by the Kramp Construction Co., Berlin, Wis., under a contract valued at $226,800. A feature of the pavement design was the provision of mud-jack sleeves in all concrete slabs placed on fills exceeding 10 ft. in depth.

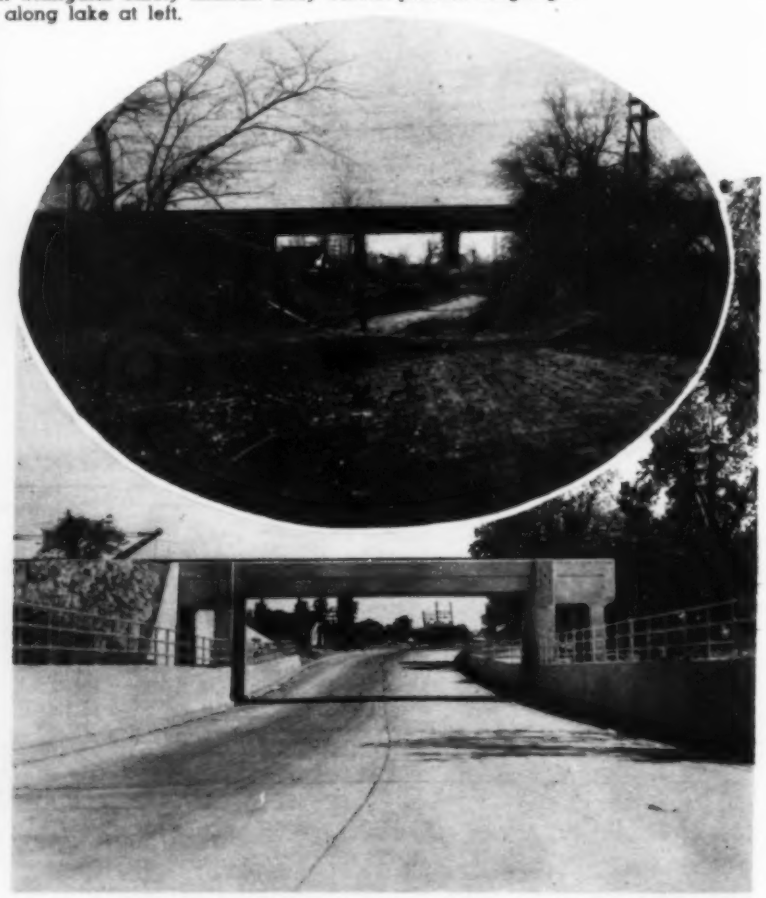
Administration—For the Wisconsin State Highway Commission, E. L. Roettiger is state highway engineer, A. T. Bleck is construction engineer and C. H. Kirch is bridge engineer. All work in the Milwaukee area is performed under the direction of Joseph A. Stransky, division engineer, Milwaukee, Wis.

SAFETY BUILT-IN *to Prevent Highway Accidents*



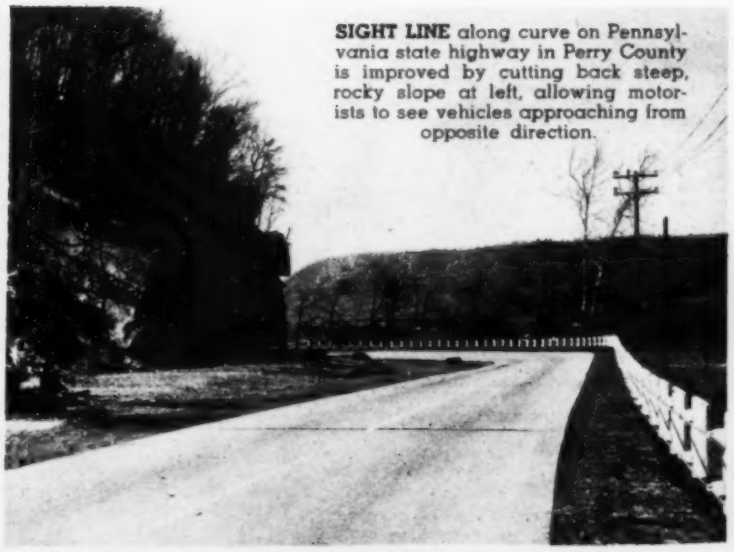
TRAFFIC SEPARATION is accomplished on Boston-Worcester Turnpike, Massachusetts superhighway, by grass-covered central safety island. Note wide shoulders along outer concrete-paved lanes to provide safe place to change tires or make mechanical repairs. Exit and entrance roads are provided with triangular safety islands. Easy curves provide long sight distances. Guard rail along lake at left.

EMBOSSED WHITE ARROWS, raised above bituminous paved surface and bordered by double traffic stripe, are placed by California Division of Highways diagonally across wide separation strip on California highway to warn motorists against crossing center line.



DANGEROUS UNDERPASS (in oval) on Riverside Drive, Tulsa, Okla., is replaced by Oklahoma Highway Dept. with modern concrete structure **(above)** flanked by sidewalks for pedestrians.

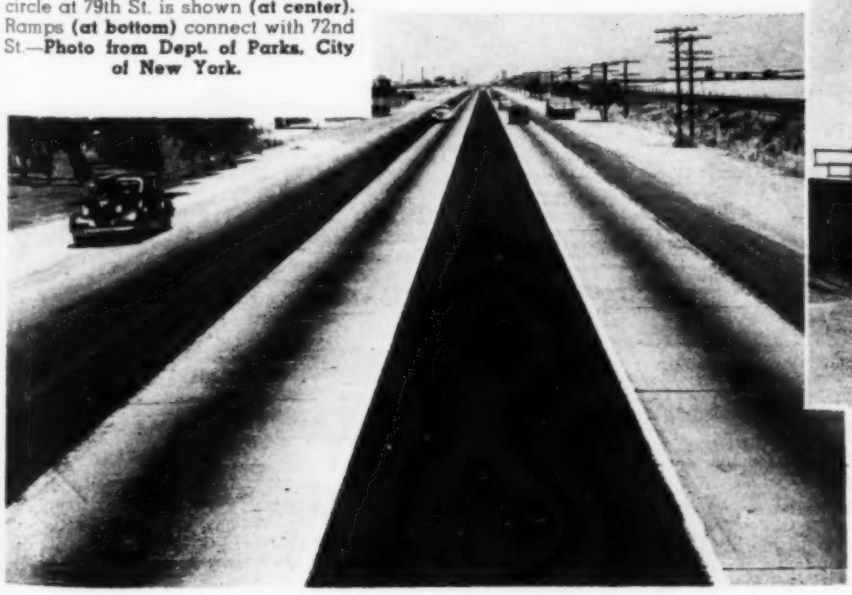
EXPRESS HIGHWAY along Hudson River, New York City, provides direct route, without crossings at grade, to George Washington bridge **(at top)** and Henry Hudson Parkway. Traffic circle at 79th St. is shown **(at center).** Ramps **(at bottom)** connect with 72nd St.—**Photo from Dept. of Parks, City of New York.**



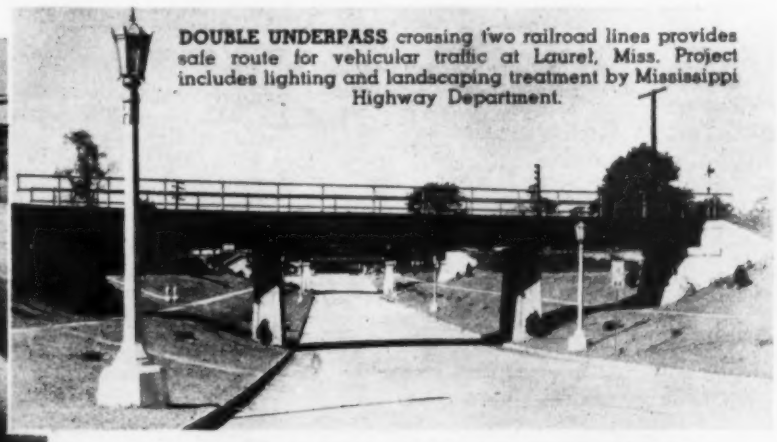
SIGHT LINE along curve on Pennsylvania state highway in Perry County is improved by cutting back steep, rocky slope at left, allowing motorists to see vehicles approaching from opposite direction.

TRAFFIC PROBLEM at intersection of legs of Y-shaped Triborough bridge, connecting New York City's boroughs of The Bronx, Queens and Manhattan, is solved by this interesting treatment, eliminating crossings at grade and also providing access to new municipal stadium **(center)** on Randalls Island.—**Photo from Dept. of Parks, City of New York.**

AIRLINE ROUTE with curves eliminated, traffic lanes widened and separated by central strip, is offered by New Jersey's Brunswick Turnpike carrying traffic between New York and Philadelphia.



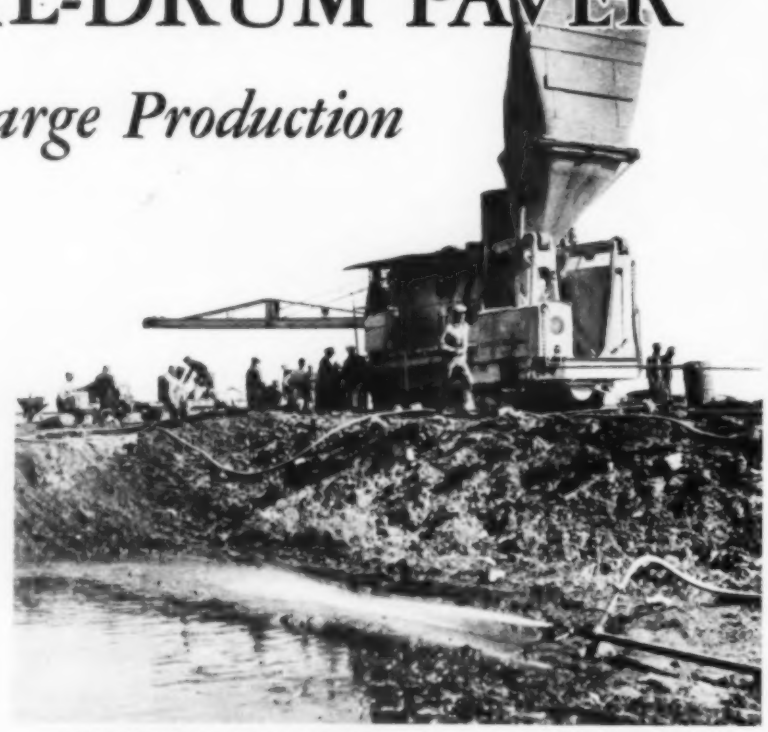
PLANNED FOR WIDENING. (Left) three-lane California highway has outer lanes of concrete and inner lane of bituminous plant-mix. When changed ultimately to four lanes, new traffic ways will be built outside existing concrete lanes and center lane will be converted into curbed dividing strip.—**Photo from California Division of Highways.**



DOUBLE UNDERPASS crossing two railroad lines provides safe route for vehicular traffic at Laurel, Miss. Project includes lighting and landscaping treatment by Mississippi Highway Department.

34E DUAL-DRUM PAVER

Maintains Large Production In Iowa



DUAL-DRUM 34E PAVING MIXER builds 14½ mi. of Iowa concrete pavement 20 ft. wide at average rate of more than 140 lin.ft. per hour. Blow-off valve at end of water line is opened to relieve pressure in tank on mixer, although special triplex pump furnishing water is pumping at this moment through 5½ mi. of 3- and 2½-in. pipe.

PRODUCING MORE than 1,000 cu.yd. of concrete pavement slab in a 13-hr. day and demonstrating a capacity for substantially greater production whenever dry batches could be fed to it with sufficient rapidity, one of the first 34E dual-drum paving mixers ever manufactured revealed good mechanical qualities and a giant appetite for raw materials on a 14½-mi. project, running east from Humboldt and Dakota City to Goldfield, Iowa, completed last fall for the Iowa State Highway Commission by the Western Asphalt Paving Corp., Sioux City, Iowa. Automatic air-powered controls of the transfer chute between the two compartments of the dual drum and of the final discharge chute took the timing of the batch cycle almost completely out of the operator's hands. Both of these controls were interconnected with the batchmeter timelock. The automatic functioning of the transfer and discharge chutes made it possible for the paver to dump batches on the subgrade at intervals of about 43 sec., based on the full cycle of 63 sec. per batch set by the engineers for this work, whenever dry materials could be delivered to the skip at this rate.

To keep up with the high rate of production, the contractor equipped the job with adequate equipment for fine grading, water supply and concrete finishing. Behind the paver, a gasoline - electric individual - motor - drive finishing machine and gasoline-powered bull float for longitudinal floating easily kept up with the maximum slab production on the contract. Water to the amount required for the dual-drum paver and for wetting burlap was supplied without interruption by a Gorman-Rupp R600 triplex pump, which maintained an adequate supply even when pumping a total distance of 7½ mi. through 5 mi. of 3-in. pipe and 2½ mi. of 2½ in. pipe.

Paving Mixer — Only three dual-drum paving mixers of 34-cu.ft. rated capacity have been manufactured, two of them being built in Milwaukee, Wis. by the Koehring Co. In addition to the paver owned by the Western Asphalt Paving Corp., another Koehring unit is serving a highway contractor in Mississippi, where the machine had laid more than 20 mi. of slab by September. Before moving its dual-drum paver to Humboldt, Iowa, the Western outfit used the machine to place the final 3½ mi. of a South Dakota contract 11.8 mi. long between Elk Point and Vermillion. During its first 5 days on the Iowa contract, the paver was allowed the customary 10 per cent overcharge, making it possible to mix a 37.4-cu.ft. batch, but thereafter the mixer was held to its rated capacity of 34 cu.ft.

Paver Operation — Powered with a slow-speed six-cylinder 120-hp. gasoline engine which easily turned the dual-compartment drum, loaded with two full batches, at about 16 r.p.m., the oversize paver functioned smoothly and quietly in all its operations. Except for the greater length of drum, frame and crawler tracks, there was nothing about its appearance to strike the eye of a roadbuilder as being obviously much larger than the conventional 27E. Weight of the loaded machine was well distributed by the larger tracks to give a low unit ground pressure corresponding roughly to that of the ordinary 27E paver.

A small compressor, built integrally with the 120-hp. motor, pumped air into a receiver which in turn furnished a supply for automatic operation of the transfer and discharge chutes. Each of these chutes was mounted on a shaft which rotated automatically at the proper point in the batch cycle to open and close the transfer opening between the compartments and the discharge opening into the bucket. During the steady, subdued rumble of the mixing operation, the occasional ph-h-h-t of escaping air was the only indication that a chute had opened or closed. Because of the automatic cycle, it was necessary that the mixer operator have the bucket under the discharge chute when this gate opened. Otherwise, the batch went on the subgrade. When necessary, the operator could suspend automatic action

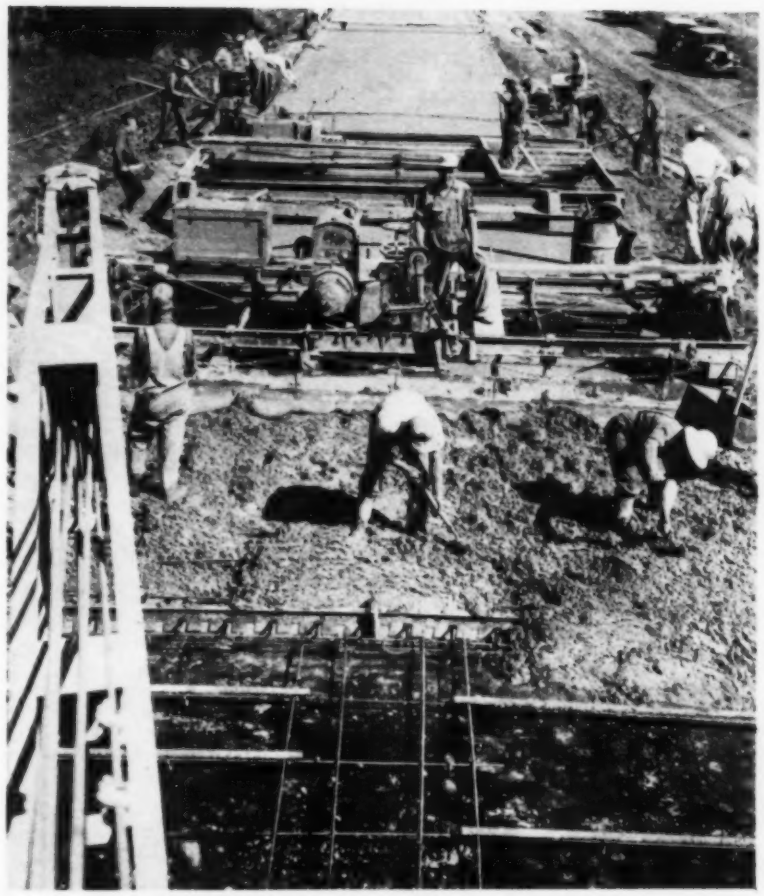
OVERALL REACH of 32 ft. provided by unusually long boom enables paver operator to spread large concrete production over extensive area. For perfect synchronization with paving cycle on this job, operator starts skip hoist at moment when bucket on outward loaded trip reaches sheave block near center of boom.

of the transfer chute and discharge chute by pulling two small levers at the level of his head, thus holding batches in the two compartments until he was ready to release them.

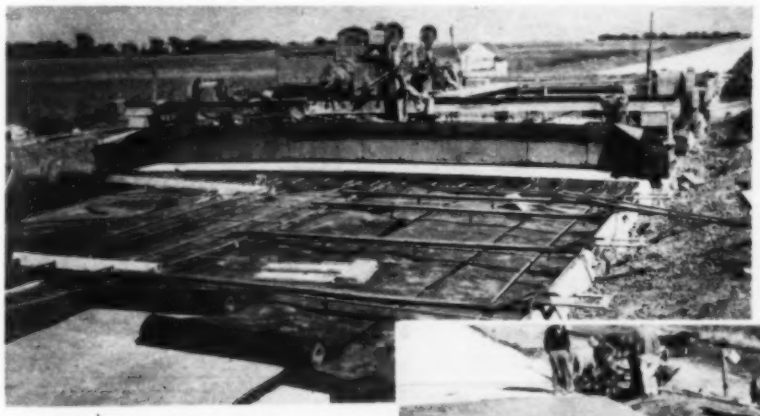
Raising the skip started the time control device when the skip struck an arm near the top of its rise. Action of the skip was swift, the full rise from the ground to top position taking only 6 to 7 sec. Successful functioning of the machine depended upon starting successive batches through the double drums at the proper time. For the automatic time cycle used on this job, the mixer operator found from experience that the ideal time to start the skip hoist was when the loaded boom bucket had traveled out to a point under the sheave block on the boom. By starting the skip at this point, the operator had time to spread the batch and return the bucket to the discharge chute before this chute automatically opened.

Two Adjacent Contracts—Adjoining contracts on State Route 10 were built by the Western Asphalt Paving Corp. as one construction job. Accompanying tables give the contract quantities and unit prices for each project. The contractor graded and paved about 2.6 mi. in Wright county on one project and about 11.9 mi. in Humboldt county on the second project. In preparation for the new construction, the State Highway Commission widened the right-of-way from 66 to 120 ft. on old location and purchased right-of-way to the full 120-ft. width on 4 mi. of new location. Excavation for roadway grade amounted to more than 350,000 cu.yd.

To resist severe climatic extremes as much as to withstand traffic pounding, Iowa builds an unsually heavy concrete slab, strongly reinforced with steel bars. The slab is provided with 1-in. transverse expansion joints at 90-ft. spacing, with transverse contraction joints at 30-ft. intervals between them. A doweled center-line contraction joint splits the slab longitudinally.

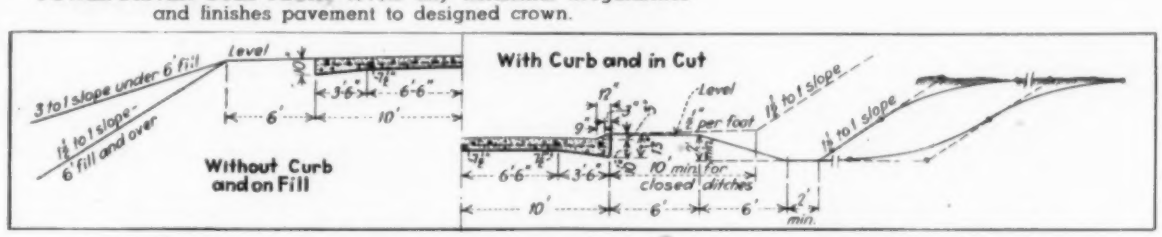


BEHIND PAVING MIXER. gasoline-electric dual-drive finishing machine and mechanical longitudinal float finish surface of concrete placed on paper-covered subgrade. Partially exposed in foreground is transverse doweled contraction joint of 20-gage galvanized sheet metal set in special shield which will be removed after concrete has been placed.



READY TO START PAVING westward toward plant No. 3 from temporary bulkhead at end of completed section, finishing machine and mechanical bull float rest on steel side forms behind expansion joint. Subgrade is covered with waterproof building paper to prevent loss of moisture from concrete into soil, and heavy reinforcement is supported by approved devices especially designed for this purpose.

POWER-DRIVEN BULL FLOAT levels any horizontal irregularities and finishes pavement to designed crown.



LIP CURB is used along both edges of slab on grades of 1 per cent or greater. Addition of lip curbs increases theoretical concrete quantity from 49.0821 to 50.2106 cu.yd. per station.

Photographs indicate the mass of reinforcement in the concrete slab and the method of assembling and supporting joints and reinforcing bars. Steel reinforcing in the slab amounted to 77,510 lb. per mile, including longitudinal and transverse bars, dowels and dowel assemblies. To keep up with progress of the paving mixer, the contractor ordinarily employed six men per shift on reinforcing steel and six to eight on joints.

Contractor's Working Layout—An accompanying map shows the three successive locations of the batching plant and the direction and length of paving operations at each set-up. The map also indicates the hauling road to the second and third locations from the commercial sand and gravel plant where the contractor obtained concrete aggregates. Cement for these two plant set-ups, No. 2 and No. 3, was shipped in bulk in box cars to Thor and to Dakota City, respectively, and was hauled by two special cement tank trucks holding 200 cu.ft. each from the unloading plant at the railroad to a somewhat similar but more elaborate cement plant, equipped with automatic weighing batchers, at the materials-handling yard. At the first set-up of the plant, in Goldfield, all materials were delivered by rail.

Batch Weights—For the concrete mixture employed in the paving operation, the theoretical dry weights per cubic yard are: cement, 602 lb.; sand, 1,446 lb.; gravel, 1,767 lb. When measuring out materials for a 34-cu.ft. batch, actually used on this work, with due allowance for moisture, typical weights were: cement, 758 lb.; sand, 1,887 lb. (including 3.5 per cent moisture); gravel, 2,245 lb. (including 0.5 per cent moisture). A water-cement ratio of 0.45 by weight required a total of 341 lb. of water per batch.

Batching Plant—On a day when the paver placed as many as 824 batches, the materials yard had to handle and measure out 312 tons of cement, 778 tons of sand and 1,010 tons of gravel. During those periods in which the mixer delivered to the subgrade as many as 70 batches per hour, as frequently happened, the plant metered out in the course of one hour 26½ tons of cement, 66 tons of sand and 78½ tons of gravel.

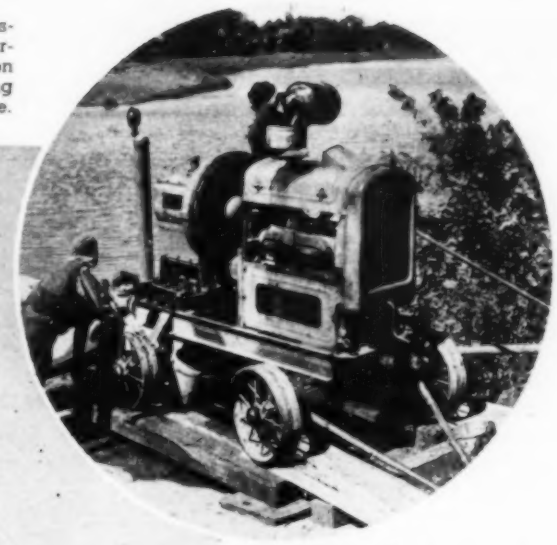
Handling material at this rate required fast operation of the batching equipment.

Progress of the paver depended on (1) the speed of the batching operation and (2) the frequency with which batch trucks could move into and out of the mixer skip. At the materials plant the speed of getting trucks out of the yard was found to depend on the cement batching equipment, which was of the electrically controlled, automatic weighing type.

Accurate, tamper-proof weight-batching of cement was assured by the automatic plant, but certain delays in its operation resulted from lack of familiarity with the equipment. The plant was erected and operated by men who never before had seen this kind of apparatus, and a good deal of time had to be spent in acquiring experience. Because of these minor difficulties, the cement batching procedure was a little slower than would otherwise have been the case.

Cement delivered to the plant by the end-dump tank trucks was discharged into a covered hopper from which a worm conveyor at ground level carried the material to a bucket elevator. This elevator raised the cement to a welded steel bin which was kept filled only to half its capacity with about 11 tons of cement pending approval of shop drawings by the bridge department of the State Highway Commission. A requirement for approval of all bin and batcher plants has been in effect in Iowa for a number of years. Power to operate the conveyors and several other mechanical services was supplied by a K. R. Wilson power plant equipped with a Ford V-8 engine which drove a G.E. 15-kw. generator. The generator furnished current to the solenoid valves, operated by automatic mercury switches, which took care of the cement weighing. In addition, it ran a Curtis compressor which supplied air for automatic vibration of the cement batcher and for the hand-controlled air dump on the same hopper. The generator also lighted the plant at night.

TRIPLEX PUMP (right) operating at pressures up to 620 lb. per square inch furnishes ample water for high-production paving and curing even when pumping through 7½ mi. of 3-in. and 2½-in. pipe.



EFFICIENT EQUIPMENT hauls and handles sand and gravel at two field locations of batching plant. Converted 2½-ton trucks haul 7 to 8 tons of sand or gravel to stockpiles, where material is handled by 1¼-yd. clamshell bucket on 55-ft. boom of crane driven by 125-hp. diesel motor.

Sand and gravel were handled at the yard by a new Koehring crane, powered by a 125-hp. diesel engine, which swung a 1¼-yd. clamshell bucket on a 55-ft. boom. The aggregates were batched through a Johnson two-compartment 70-ton bin and weighing hoppers.

Hauling Aggregates — To haul sand and gravel from the commercial plant to the second and third locations of the materials yard, the contractor operated a fleet of 10 Ford trucks which had been built up from their original 2½-ton rating to 5-ton rated capacities by means of Truckstell conversions. On the converted trucks were mounted St. Paul bodies and hoists, with which the drivers hauled and dumped 7 to 8 tons of sand and gravel per trip.

Batch Hauling—Single-batch trucks hauled dry materials from the plant to the mixer. Batch hauling was sublet to Otto Holton, Sioux City, Iowa, who ordinarily ran from 17 to 22 trucks to keep the double-drum mixer supplied.

Progress and Employment — For the entire job, the double-drum paver averaged a little more than 57 batches per hour. An accompanying table gives the progress for each day in linear feet of pavement and in number of batches, together with the daily average of linear feet per hour and batches per hour. It should be noted that the average progress is given for the net working time, with major delays deducted from the total working time.

Actual progress on the job did not approach the real capacity of the double-drum paver. It was not to be expected that the contractor would touch maximum potential production on the mixer's first job. Under a similar mixing specification, the same contractor in the future may be able to average 75 batches per hour.

On a typical week while paving operations were in progress, the general contractor in two shifts em-

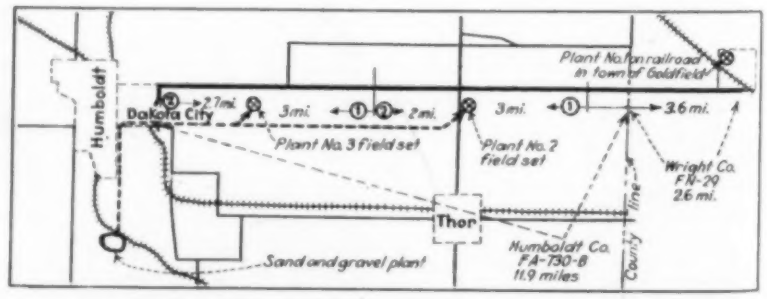
Contract Quantities and Unit Prices

PROJECT A — HUMBOLDT COUNTY, IOWA — 11.897 MI.

	Quantity	Unit Price	Amount
Excavation, roadway & borrow, cu.yd.	327,016	$.13	$42,512.08
Excavation, peat, cu.yd.	15,060	.20	3,012.00
Type A concrete pavement, sq.yd.	138,041.6	1.92	265,039.87
Type A flumes, complete, each	49	60.00	2,940.00
Type B flumes, complete, each	12	60.00	720.00
Conc. entr. pipe, 15-in., lin.ft.	560	1.00	560.00
Conc. entr. pipe, 18-in., lin.ft.	300	1.30	390.00
Conc. entr. pipe, 24-in,, lin.ft.	200	1.80	360.00
Finish earth shoulders, lin.ft.	62,817.1	.10	6,281.71
Add. or less curb than shown on plans, lin.ft.		.06	
Add. or less conc. slope drain than shown, lin.ft.		2.00	
Add. or less metal slope drain than shown, lin.ft.		2.00	
Clearing & Grubbing			3,021.40
			$324,837.06

PROJECT B — WRIGHT COUNTY, IOWA — 2.585 MI.

Excavation, roadway & borrow, cu.yd.	14,371	$.15	$ 2,155.65
Excavation, channel, cu.yd.	1,420	.20	284.00
Excavation, approach, cu.yd.	150	.20	30.00
Type A concrete pavement, sq.yd.	29,835.8	2.03	60,566.67
Type A flumes, complete, each	10	70.00	700.00
Type B flumes, complete, each	8	70.00	560.00
Finish earth shoulders, lin.ft.	13,653.5	.10	1,365.35
Add. or less curb than shown on plans, lin.ft.		.06	
Add. or less conc. slope drain than shown, lin.ft.		2.50	
Add. or less metal slope drain than shown, lin.ft.		2.50	
			$ 65,661.67



PAVING LAYOUT for two adjoining contracts indicates three locations of batching plant and truck-hauling route from sand and gravel plant to second and third locations. Numbers in small circles indicate sequence of paving operation toward each plant location.

ployed a total of more than 250 men, while the hauling subcontractor employed more than 40 men.

Rough Grading—Four Caterpillar RD8 (95 drawbar horsepower) diesel tractors, each drawing a LeTourreau 12-yd. pneumatic-tired carrier scraper, moved all of the 360,000 cu.yd. of excavation required for the rough grade except 12,000 to 15,000 cu.yd. of peat which was removed by a small dragline and wasted outside the road bed.

Fine Grade—Preliminary trimming of the subgrade was done with a motor patrol grader aided by a tumblebug scraper drawn by a 30-hp. gasoline tractor. An R. B power subgrader planed the subgrade to desired cross-section profile, and final compaction was obtained with a McCormick-Deering tractor which had its two rear wheels loaded with concrete.

Form trenches were dug by a Carr formgrader. As the job carried only 5,800 lin.ft. of Metaform steel road forms sufficient for 2,900 lin.ft. of pavement, the form crew had to work rapidly during the morning hours to keep the forms stripped and set to final grade for 400 or 500 ft. ahead of the mixer.

Shoulders—Additional material to build up shoulders following the paving operation was loaded out of borrow ditches into light end-dump trucks by two small draglines, of ¾- and ⅝-yd. capacities. For slope and shoulder finishing, the contractor used a Caterpillar power grader and a Moritz shoulder machine, each of which was drawn by a 60-hp. gasoline tractor.

Administration — For the Iowa State Highway Commission, F. R. White is chief engineer, and F. H. Mann is assistant chief engineer. Operations on the two contracts described in these notes, as well as work on other projects in the adjacent area, were under the direction of A. A. Lyon, resident engineer, Humboldt, Iowa.

For the contractor, D. O. Bradbury, superintendent, was in charge of the work, acting under the general supervision of Hubert Everist, president, Western Asphalt Paving Corp., Sioux City, Iowa.

Double-Drum Paver Progress Record

ON TWO ADJOINING IOWA CONTRACTS

PROJECT A — HUMBOLDT COUNTY

Mixing 37.4-cu.ft. batches

Date	Lin. ft.	No. batches	Net time, hr.	Lin. ft. per hour	Batches per hour
7-26	307	115	3.0	102.3	38.3
7-27	1,121	415	10.9	102.8	38.1
7-28	666	247	5.9	112.9	41.9
7-29	616	231	5.7	108.1	40.5
7-30	1,338	484	9.9	135.2	48.9
Totals	4,048	1,492	35.4		
	Average linear feet per hour			114.35	
	Average batches per hour			42.14	

Mixing 34-cu.ft. batches

Date	Lin. ft.	No. batches	Net time, hr.	Lin. ft. per hour	Batches per hour
7-31	1,258	489½	10.5	119.8	46.6
8-23	1,128	462½	8.6	131.2	53.8
8-24	570	232	7.7	74.0	30.1
8-25	1,385	549	10.4	133.2	52.8
8-27	1,578	636	10.4	151.7	61.2
8-30	1,849	733	12.0	154.1	61.1
8-31	2,011	793	12.6	159.6	62.9
9-1	1,659	655	10.4	159.5	63.0
9-2	1,677	664	11.3	148.4	58.8
9-3	1,891	747	11.2	168.8	66.7
9-4	2,050	817	12.2	168.0	67.0
9-6	1,960	762	11.7	162.5	65.1
9-7	2,058	821	13.0	158.3	63.1
9-8	2,072	824	12.9	160.6	63.9
9-9	1,919	756	11.7	164.0	64.6
9-10	730	288	4.2	173.8	68.5
9-11	1,701	672	11.5	147.9	58.4
9-12	312	124	3.0	104.0	41.3
9-15	532	218	3.5	152.0	62.2
9-16	1,695	690	11.0	154.1	62.7
9-17	2,033	809	12.7	160.1	63.7
9-18	2,007	806	12.8	156.8	62.9
9-20	1,951	781	12.1	161.2	64.5

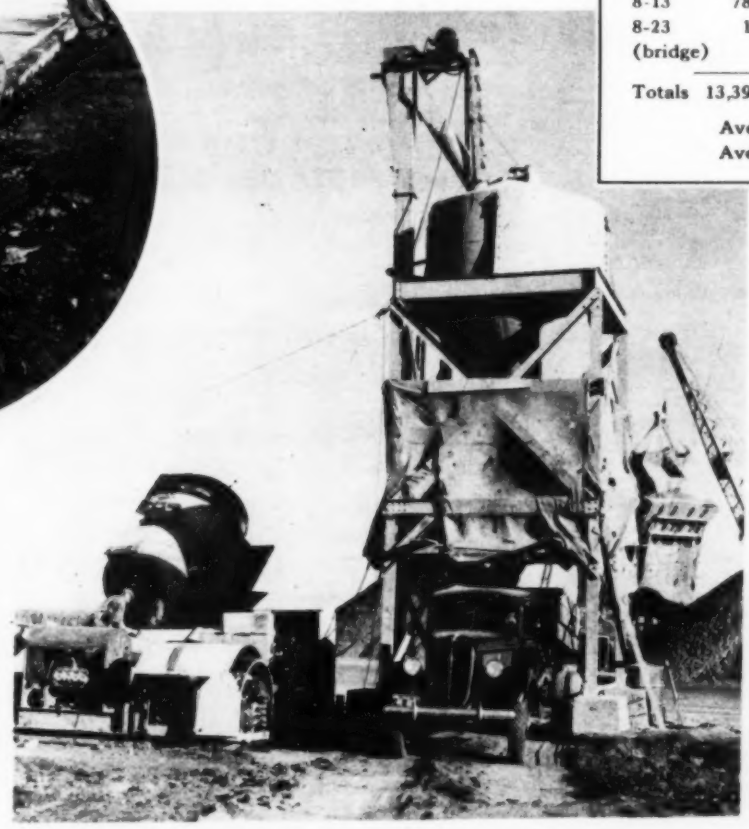
Mixing 34-cu.ft. batches

Date	Lin. ft.	No. batches	Net time, hr.	Lin. ft. per hour	Batches per hour
9-21	1,594	625	10.3	154.7	60.7
9-22	1,990.1	785	12.9	154.2	60.8
9-23	1,753	683	11.0	159.3	62.1
9-25	1,883	730	12.3	149.0	59.3
9-28	609	242	5.6	108.8	43.2
9-29	1,464	602	11.05	133.1	54.7
9-30	1,506	605	11.5	130.9	52.6
10-1	38	16	.5	76.0	32.0
10-2	1,476	601	12.7	116.2	47.3
10-4	1,707	678	11.8	114.7	57.4
10-5	269	107	2.2	122.3	48.6
10-6	1,871	756	11.7	159.9	64.6
10-7	1,640	655	10.5	156.2	62.4
10-8	1,314	529	9.9	132.7	53.4
10-9	1,093	443	7.9	138.3	56.1
10-11	1,780	704	12.3	144.7	57.2
10-12 (bridge)	97.3	43	3.3	29.4	29.5
Totals	58,110.4	23,132	394.85		
	Average linear feet per hour			147.17	
	Average batches per hour			58.58	
Grand Totals	62,158.4	24,624	430.25		
	Average linear feet per hour for entire Project A			144.35	
	Average batches per hour			57.23	

PROJECT B — WRIGHT COUNTY

Date	Lin. ft.	No. batches	Net time, hr.	Lin. ft. per hour	Batches per hour
7-31	156	60	1.1	141.8	55.0
8-3	1,414	562	10.9	129.7	51.5
8-4	1,480	620	11.5	128.7	53.9
8-5	1,603	636	10.8	148.4	58.9
8-6	1,168.7	486	9.7	120.5	50.1
8-7	1,746	704	11.9	146.7	59.2
8-9	1,706	661	12.5	136.5	52.9
8-10	1,858	731	11.3	164.4	64.7
8-12	1,454	575	8.9	163.4	64.6
8-13	789.5	313	4.2	188.0	74.5
8-23 (bridge)	15	10	1.0	15.0	10.5
Totals	13,390.2	5,358	93.8		
	Average linear feet per hour			142.76	
	Average batches per hour			57.12	

TO REDUCE HEAT ABSORPTION by black surface of concrete pavement cured with sprayed asphalt emulsion, Iowa specifications require contractor to whitewash top and sides of slab. Hand brushing is necessary along edges.



BULK CEMENT (right), delivered by tank truck to ground hopper, is elevated to overhead bin from which it is weighed out by electrically operated automatic batching equipment. Gasoline-powered 15-kw. generator at left furnishes all power needed to run cement plant and to light entire materials yard at night.

IN 1935 the City of Baltimore was confronted with the problem of expanding a large amount of WPA and PWA money in order to employ a maximum amount of labor and obtain results of a permanent nature. It was decided at that time to repave a number of old streets where the paving had disintegrated or had been worn out from use over

29TH ST. BRIDGE (right), paved with brick, has 40 ft. roadway, two 7 ft. 10 in. sidewalks, and is 1,375 ft. in length.

ASPHALT-MASTIC CUSHION, ¾ in. deep, is shaped to exact crown by use of 20-ft. templet supported by steel rails.

Bridge Roadway

Paved With Brick

By CHARLES F. H. FOARD
Assistant Highways Engineer, Department of Public Works, Baltimore, Md.

a period of many years. Some of these streets have been repaved with vitrified brick. Modern methods were used and the results obtained were such that we have had many letters from the residents and users of these streets commending us on their appearance, non-skid surface, durability and riding qualities. Approximately 165,000 sq.yd. of brick paving have been laid to date and several projects are now in the course of construction. Practically all of this paving consisted of a surface of 3-in. vertical-fibre, lug, vitrified brick, on a ¾- to 1-in. mastic cushion, bituminous filler which was removed from the surface of the brick, and a 7-in. cement concrete base. The work mentioned above was financed through our Works Progress Administration program.

One of the outstanding brick paving projects completed in Baltimore is the roadway of the 29th St. bridge over Jones Falls Valley. The bridge carries one roadway 40 ft. in width between curbs and two sidewalks each 7 ft. 10 in. wide. There are two 232-ft. clear main arch spans with three reinforced concrete arch ribs in each span. There are also three 30-ft. clear reinforced concrete filled spandrel arches on each side of the two main spans. The total length of the bridge is 1,375 ft. The brick paving of the roadway blends with the coursed rubble masonry facing of the bridge, giving a very pleasing appearance. The concrete bridge

STRAIGHT-EDGE 10 ft. long checks smoothness of mastic cushion surface prior to placing bricks.

floor was laid to the proper grade and crowned section, and the following construction methods were used in the brick paving:

Mastic Cushion—A mastic cushion was laid to a depth of ¾ in. immediately in advance of the laying of the brick. Care was taken that this cushion would not get its final set until after the bricks had been laid and rolled. This cushion was mixed at an asphalt plant in the following proportions: Dry sand, 95 per cent by volume; asphalt cut-back, 5 per cent by volume. The cut-back was

BRICKS. 3 in. deep, are of vertical fibre, lug type, 4 in. wide and 8½ in. long, jointed with asphalt filler.

TRAFFIC LANE MARKERS. in form of light bricks, are built into paved surface.

made to conform with the specifications approved by the American Public Works Association.

After spreading the cushion to an approximate depth of ¾ in., a templet 20 ft. long and cut to the exact crowned section of the street was used to shape the cushion. This templet was supported in the center of the roadway and at the curb line by steel rails constructed for that purpose. The templet was operated in a longitudinal direction, which tended to give a perfect grade for the laying of brick. The cushion was then rolled with a light hand roller and the surface brought to a true grade and checked with a 10-ft. straight-edge.

Brick—Vertical fibre, lug, vitrified brick, having a depth of 3 in., a width of 4 in., and a length of 8½ in., were used. The bricks were laid at right angles to the face of curb and necessary angle closures were made on a line about 2 ft. from the header at each approach. Extreme care was taken to keep the transverse lines of the brick as straight as possible. This adds greatly to the appearance of the finished paving. The roadway is divided into four traffic lanes, each 10 ft. wide. Buff bricks were used as traffic lane markers.

Rolling — After the bricks were laid and lined up properly a 5-ton roller was operated on planks laid on the brick surface in a longitudinal direction. The bricks immediately adjacent to the curbs were thoroughly tamped before the rest of the surface was rolled. The use of planks for rolling reduces the chipping of bricks to a minimum and tends to give a more uniform section and riding surface.

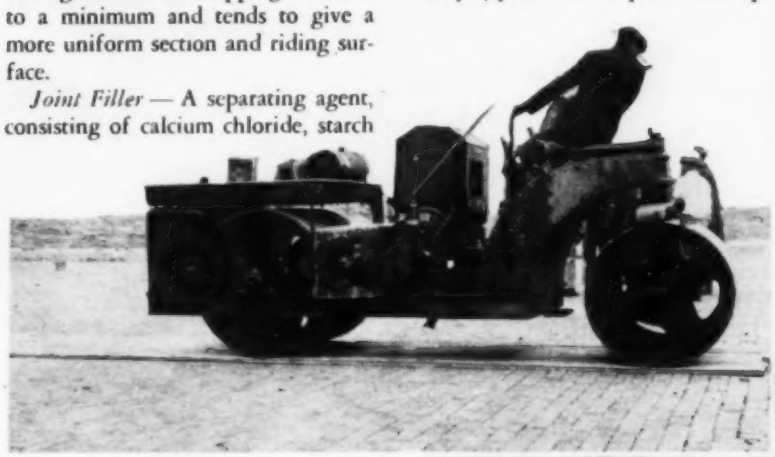
Joint Filler — A separating agent, consisting of calcium chloride, starch and water, was then sprayed or applied with brushes to the surface of the brick. Both methods were used and while the spraying was much faster, the brush method seemed to be more satisfactory because there was less chance of the separator getting into the joints between the brick.

The asphalt filler then was applied at a temperature of from 400 to 450 deg. F. The asphalt filler used was made to conform with the specifications of the American Public Works' Association.

The removal of the excess filler may be started as soon as the asphalt has cooled and hardened to such an extent that it can be cut with scrapers. If the operation is started too soon some of the filler may be pulled out of the joints. While it is possible to remove this excess filler after several hours, it was found from experience that from 15 min. to 1½ hr., according to the air temperature, is the most satisfactory time to allow the filler to remain before removing the excess from the paved surface.

The asphalt was applied, care being taken that all joints were thoroughly filled. After allowing the filler to settle in the joints for a short time, a second application was poured. The depth of this filler on top of the bricks was approximately ¼ in.

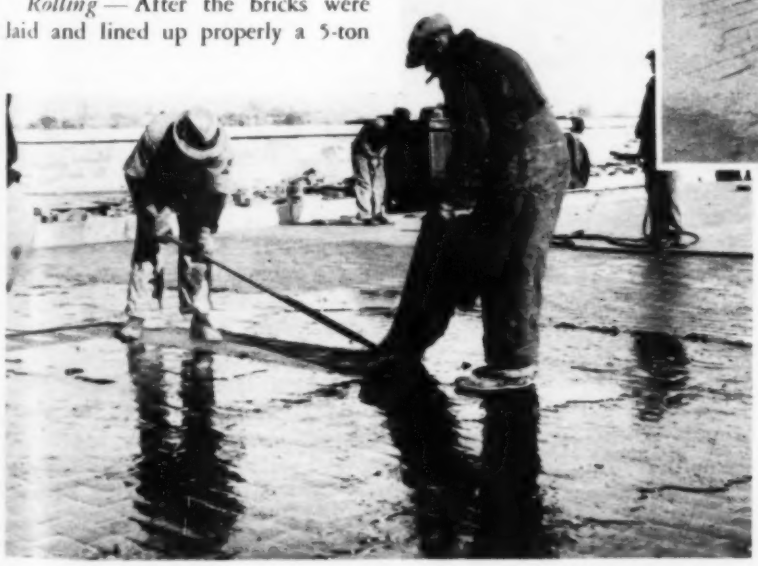
It has been noticed on some of the streets that have been paved for a year or more that some small areas show signs of a slight movement of the brick. In some cases there is a settlement of a row of brick; in other places a few bricks may be slightly tilted or a small opening may appear in the joints. We have determined that any of these irregularities could be caused by a movement of the mastic cushion where there is very little adhesion with the concrete base.



WOOD PLANKS are placed to carry 5-ton roller, thereby reducing chipping and giving uniform riding surface in finished pavement.

SEPARATING AGENT. consisting of mixture of calcium chloride, starch and water, is applied both by spray and by hand brushing to facilitate removal of excess joint filler.

JOINTS ARE POURED (right) with asphalt heated to 400 to 450 deg. F., allowed to settle and filled to top by second pouring.



EXCESS FILLER is easily removed by scrapers as bond with paved surface is prevented by prior application of calcium chloride and starch.

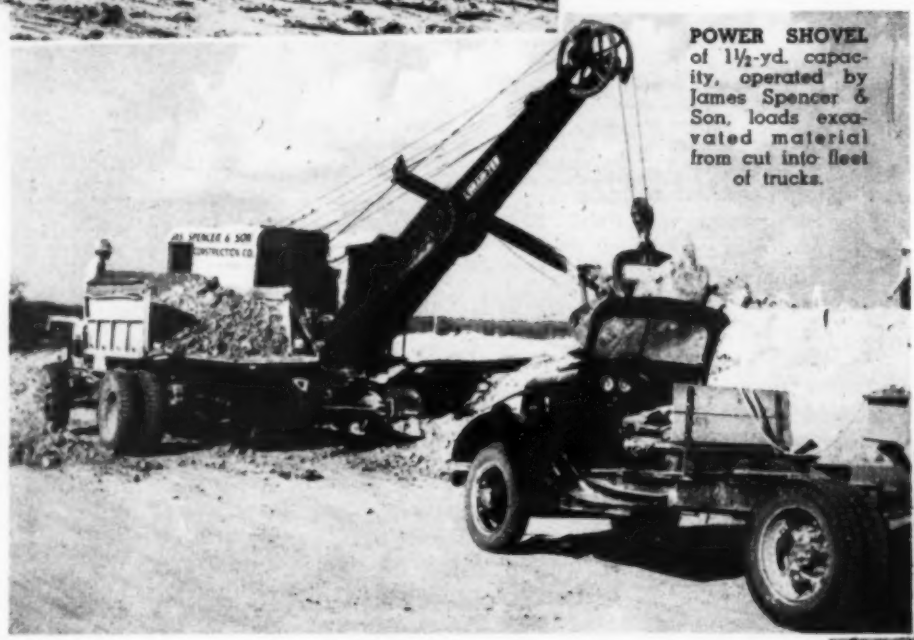
On one of our projects now in progress we are applying a spray coat of about 1/15 gal. of cut-back asphalt per square yard to the concrete base before the cushion is laid. This should prevent any movement, and I believe will solve the problem. The cut-back used for this purpose is the same material used in the preparation of the mastic cushion.

Expansion Joints—On one of our earlier projects expansion joints were used in the construction of the concrete base. These joints were of the pre-molded type and were spaced longitudinally about 12 ft. apart and transversely about 25 ft. apart. We found that the action of the sun on exposed areas caused the joints to extrude and resulted in a decided displacement of the bricks directly over them. This practice has been discontinued and expansion joints are now used only at the curb lines. The base is laid in lanes and the construction joints between the lanes apparently cause no movement on the surface.

The general contractor on the 29th St. bridge was the Potts & Callahan Contracting Co., of Baltimore. The brick paving was sublet to Drummond & Co., Inc., of Baltimore.

Mississippi Builds *to Cost*

ELEVATING GRADER hauled by tractor loads into truck on approach to one of 11 bridges on 12-mi. project of Chickamauga Construction Co., of Atlanta.



POWER SHOVEL of 1½-yd. capacity, operated by James Spencer & Son, loads excavated material from cut into fleet of trucks.

MISSISSIPPI is speeding work on a $42,500,000 road-building program. Until 1936 the availability of funds had been so irregular and the amounts so inadequate that only small sections of paving had been constructed here and there throughout the state, without regard to the completion of any designated route. Many of the roads were laid out years ago with little thought of conserving distance or eliminating hazards, and while they were picturesque, inviting trails, they were beset with many dangerous railroad crossings.

With 1936 came a new day and the first real highway program for Mississippi. The state had found a champion of highways in Governor Hugh White. A PWA grant of $15,000,000 was matched with $18,500,000 by the state. The 1936 and 1937 allotment of Federal Aid brought in $4,500,000 more, which was also matched by the legislature, and Mississippi had $42,500,000, available for highway construction. On the system of roads called the priority system, designated by the legislature for improvement under this program, there are 2,720 mi. This system contained about 1,000 mi. of paving scattered throughout the state, with an additional mileage graded, drained and ready to pave, leaving an unimproved mileage of 1,376. Much relocation was necessary to shorten routes, eliminate dangerous curves, and reduce the number of grade crossings.

In many ways Mississippi is fortunate in that its first real highway program is just getting under way. When this extensive program is completed the state will have a system of modern paved highways, built in accordance with latest developments in highway construction practice. This is possible now without any increase in taxation. Of the gasoline tax per gallon 1¼c. has been set aside for retirement of the notes authorized for matching PWA and Federal-Aid funds. While the amount of money provided for the present program will not be enough to give the state a complete highway system, the ease with which the highway department's share of the gas tax is meeting the interest and maturity on the present bonds makes Governor White optimistic about added funds.

DRAGLINE is used on Spencer's Laurel job to load into 8-yd. tractor-hauled wagons and motor trucks.

GRUBBING (right) problem assumed sizable proportions on Spencer job at Laurel, involving removal of trees from relocation through heavily wooded section.

With the greater part of the priority system paved, maintenance costs will be reduced and an increase in gasoline tax receipts is expected. When the present program is completed Mississippi will owe only $23,000,000. The state has been able to take advantage of the mistakes other states have made, of the newest developments in highway design, and of the efficiency and economy of modern road-building machinery, which gives it better roads at lower cost.

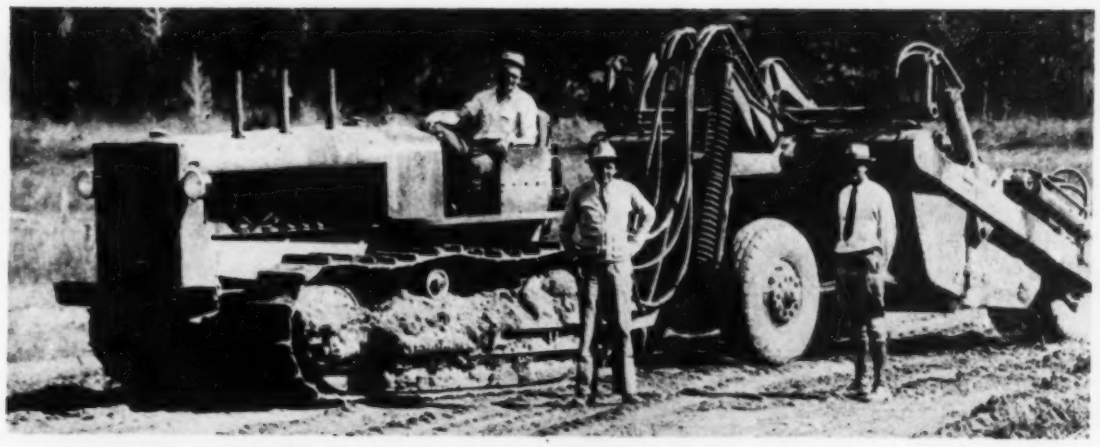
Thus, in May, 1936, Mississippi had $42,500,000, available for road construction, the program had been mapped out, and approximately $38,000,000 had to be contracted for by

PNEUMATIC-TIRED HAULING UNITS, tractor-operated, keep dragline busy on F. S. Neeley's job in Madison County.

H. A. LONG (left), superintendent for Chickamauga Construction Co., in charge of job at De Sota.

Road System

$42,500,000



CARRYING SCRAPER handles earth on grading operations of James Spencer & Son Co., for whom M. W. AGNEW (center) is superintendent on two jobs at Stewart.

July, 1937. During the first 12 months of the program 232 contracts were awarded to 80 different contractors. At this writing more than 100 contractors are working on approximately 200 contracts in the state, and nearly all of the original amount is under contract. Through contractors, employment has been given to more than 11,000 men.

Construction Problems — Unusual problems have arisen on many of these Mississippi jobs. On Mississippi highway No. 15, south of Laurel, the James Spencer & Son Construction Co., of Dallas, Texas, has a 12½-mi. job which is all new location, cut through a veritable jungle. The trees are so close that when cut, one could almost travel the whole length of the job by jumping from one stump to another. Mr. Spencer says more of the trees are beneath the ground than on top. The stumps are loosened with dynamite and then pulled out with tractors. They are piled in stacks 10 to 15 ft. high and burned, but the ground is left so full of roots that the dragline has trouble loading, and every few minutes must stop and pull the roots to get them out of the way.

Drainage is another problem on this job, and a deep drainage channel had to be cut along one side of the right-of-way. Approximately 400,000 yd. of earth will be moved. In this stretch of new road there is one curve that will be 2½ mi. long. On this job Spencer has been using one ¾-yd. Bucyrus-Erie dragline loading into two Ford trucks, and an 8-yd. crawler wagon pulled by an Allis-Chalmers model WK tractor. Several Gar Wood 10-yd. scrapers pulled by Allis-Chalmers and Caterpillar tractors will be moved to this job as soon as his projects at Lumberton and Stewart are completed.

At DeSota the Chickamauga Construction Co., of Atlanta, is grading a 12-mi. stretch of U. S. 45. This job is in the lowlands of the Chickasawhay River, an innocent looking stream that becomes a raging torrent and overflows its banks if given half a chance. The ground is always damp, and H. A. Long, the superintendent, says he has had five borrow pits, just off the right-of-way, that filled with water after they had gone down only 2 or 3 ft. Eleven bridges are to be constructed in this 12 mi. of highway, 9 of timber and 2 of concrete. A 48-in. Austin-Western elevating grader pulled by an Allis-Chalmers controlled ignition L-O tractor loads into a fleet of International and Ford trucks. An Allis-Chalmers WKO, with Baker bulldozer, levels off the earth on the fills and approaches to timber bridges, and a similar tractor is used with a blade grader for finishing.

On Spencer & Son's job at Houston, U. L. Ford, superintendent, says that no unusual conditions were encountered, and that they were fortunate in having no serious trouble of any kind with their equipment. Machines are lubricated as regularly as if done by clockwork. Not a single grease fitting is missed and each machine is carefully checked each time it is greased. In almost seven months' operation only two days were lost because of mechanical difficulty, and the job has proceeded in record fashion with Mr. Ford getting maximum production from every unit.

This job at Houston contained approximately 214,000 yd. of earth to be moved, with 30,000 yd. of sand topping, and is practically finished. A 1½-yd. Lorain shovel, 4 Ford and 4 Hug trucks were used in the heavy cuts and long hauls, while on all the short hauls two Gar Wood 10-yd. scrapers pulled by Allis-Chalmers oil tractors, and a 5-yd. Continental scraper pulled by a Caterpillar RD-7 worked at peak production. The earth was exceptionally tight, and some difficulty was experienced with springs in the heavy cuts. On this job were 16 mules pulling four fresnos for finishing. These animals were holdovers from the days when James Spencer did all his work with mules, and their work with the fresnos in finishing more than paid their keep. Spencer has also found that his Gar Wood scrapers are ideal for finishing as well as moving dirt; he has seven on his various Mississippi jobs.

These jobs are typical of what is going on in Mississippi where a great state, rich in history and tradition, is being pulled out of the mud to take its place on the highway map of the nation.

The road building program in Mississippi is being carried on under the direction of the State Highway Department, of which E. D. Kenna is director; R. A. Harris, chief engineer; E. B. Cavallo, construction engineer; and Sam J. Dalton, maintenance engineer.

DRAINAGE is handled by channel cut alongside new roadway location. Note density of undergrowth and trees in background.

Present and Accounted For —

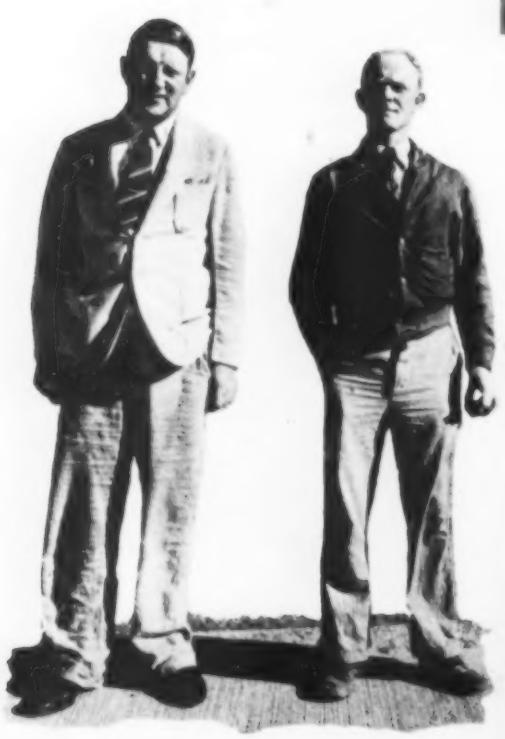
A Page of PERSONALITIES

CONSTRUCTION EXECUTIVE — MARY K. NIERLING, secretary and treasurer of the W. H. Noel Co., contractor of Jamestown, N. D., is also president of the North Dakota Highway Contractors' Association, which recently became affiliated with the American Road Builders' Association. Miss Nierling has been active in the management of the Noel construction organization for 15 years.

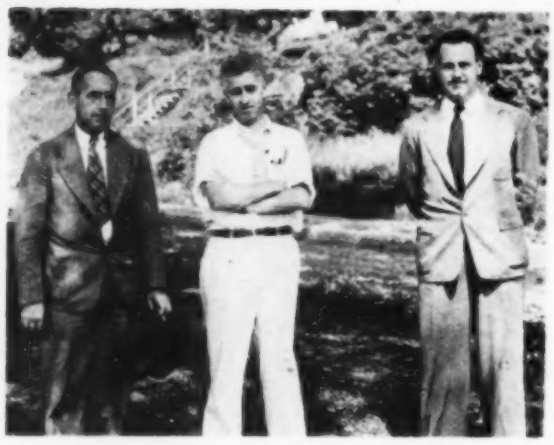
TO HEAD A.R.B.A. — MURRAY D. VAN WAGONER, State Commissioner of Highways of Michigan, will take office this year as new president of the American Road Builders' Association, succeeding Col. Willard Chevalier. Mr. Van Wagoner has headed the Michigan Highway Commission since 1933 and was re-elected for a second four-year term of office at last state elections.

DUAL-DRUM PAVER OPERATION on two Iowa contracts is directed for Western Asphalt Paving Corp., Sioux City, Iowa, contractor, by D. O. BRADBURY (left), superintendent, and for Iowa State Highway Commission by A. A. LYON, resident engineer.

TO STIMULATE BUILDING — By appointment of President Roosevelt last November, HENRY C. TURNER, president, Turner Construction Co., New York City, became a member of a committee of business and government leaders to stimulate construction of houses by private capital. The committee's activities are entirely independent of the newly created U. S. Housing Authority.



RELOCATION AND CONSTRUCTION of 14 mi. of divided-lane concrete highway on U. S. 30 in northwest corner of Indiana make satisfying progress under direction of C. H. SWEENEY (left), supervising engineer in charge of entire project for State Highway Commission, and F. S. HILL, resident engineer on contract section built by Thomas McQueen, Inc.



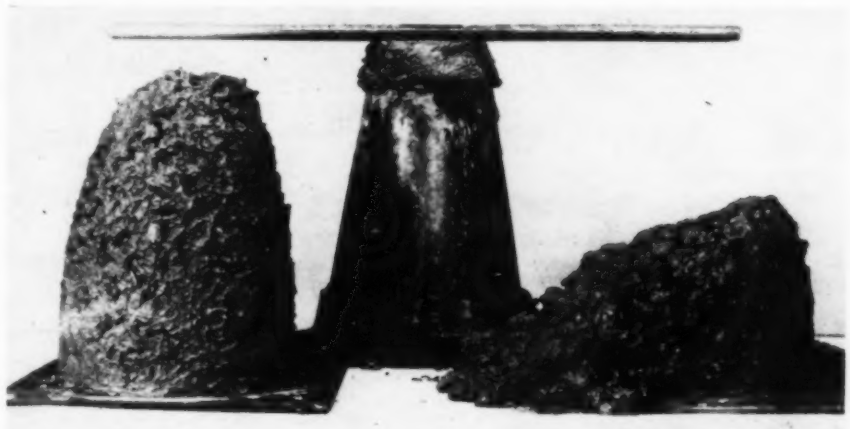
MASSACHUSETTS HIGHWAY CONTRACTS described elsewhere in this issue are executed under direction of **(left to right)** J. E. O'NEIL, district construction engineer; LEWIS J. FRITZ, resident engineer on Newburyport Turnpike and Squire Road Extension; J. A. McCARTHY, district engineer, State Department of Public Works, District 5, Beverly, Mass.

CONSTRUCTION EQUIPMENT NEWS

(ALL RIGHTS RESERVED)

Review of Construction Machinery and Materials for JANUARY, 1938

HYDRAULIC CONTROLS (above) automatically operated by mixer's timing mechanism are features of new 27E dual-drum paver and new 27E single-drum paver. Interlocked with batchmeter timing device for automatic operation under normal circumstances, hydraulic controls in both machines can be operated by finger-touch levers placed in convenient positions on operator's platform. On dual-drum paver, hydraulic controls open and close water tank valves and swing both transfer chute and discharge chute into mixing position. On single-drum paver, hydraulic controls operate similar functions, with exception of transfer chute, absent on single-drum unit. Both machines will be on exhibit at Road Show in Cleveland, Jan. 17-21. — **Ransome Concrete Machinery Co., Dunellen, N. J.**



CONCRETE PLACEABILITY (above) of "dry" mixes — better workability with less water — is made possible by the addition of Pozzolith, a ferric alumino silicate in liquid suspension, having early-effective pozzolanic properties. This product is added in the proportions of 1 gal. per cubic yard of concrete to all mixes using up to 5½ sacks of cement per cubic yard, with an additional quart of Pozzolith per sack of cement in excess of 5½. With this admixture it is possible to make a substantial reduction in the water-cement ratio of the mix and obtain a readily workable concrete of increased strength, density and watertightness. As an indication of the comparative placeability of concretes with and without the addition of Pozzolith, the accompanying photograph shows, at the left, a plain mix having a slump of 1¾ in. and, at the right, a Pozzolith mix with a slump of 6½ in.; in each case the water-cement ratio was the same. The compressive strengths after 7 days of the untreated mixes were, respectively, 3,180 lb. and 4,230 lb. — **Master Builders Co., 7016 Euclid Ave., Cleveland, Ohio.**

RUBBERIZING COMPOUND called "Self-Vulc Insulator" for insulating and waterproofing jobs requires no primer when applied to metal or other surfaces. Product incorporates quality of primer with self-curing, cold-curing rubber which can be applied by unskilled labor by dipping, spraying or by hand brushing. Makes steadfast bond in one application but repeat coats of any desired thickness may be added. Vulcanizing period 1 hr. between coats. No shrinkage in application. Compound is said to resist and stop corrosion caused by alkalies, salt solutions, mild acids and their fumes and is used for covering girders, ducts, ventilators, hoods, pipes (exterior and interior), tanks, vats, tubs, walls, ceilings, bodies and frames of tank cars and structural steel. **—Self-Vulcanizing Rubber Co., 605 W. Washington Blvd., Chicago, Ill.**

Brute power and rugged endurance is built into Duff-Norton Genuine Barrett Automatic Lowering Jacks—available in various capacities up to 20 tons.

These smooth running Duff-Norton Ball Bearing Screw Type Jacks are used and preferred the country over for general purpose heavy duty service.

Available in 15 to 100 tons capacities.

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Stronger than the proverbial ox, Duff-Norton Jacks are the faithful beasts of burden that have won the confidence and preference of construction engineers everywhere on sheer merit and outstanding performance.

Just as the strength of the ox was improved by centuries of careful breeding, so has the mechanical power and efficiency of Duff-Norton Jacks been refined to their high efficiency today by more than 50 years of progressive improvements.

THE DUFF-NORTON MANUFACTURING COMPANY
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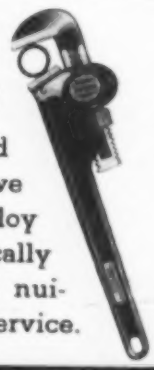
Cut Your Cutter Wheel Expense with a RIDGID

You see at once better cutting and wear because the wheel in a RIDGID is a thin blade, coined out of alloy tool steel, hammered, heat-treated, assembled in a solid hub. Gives you far more cuts per wheel. Assures quicker easier cleaner cuts, practically no burr. Reinforced cutter housing guaranteed not to break or warp, always cuts true. Try one at your Jobber's. Find out why hundreds of thousands of users take pride in owning the RIDGID. For economy and better cutting, buy the better looking RIDGID.

The Ridge Tool Co., Elyria, Ohio

Stop 75% of Your Pipe Wrench Repairs



RIDGID housings guaranteed against break or warp—or we replace free. Entire tool of alloy metals guaranteed. Practically ends repair expense and nuisance of wrenches out of service.

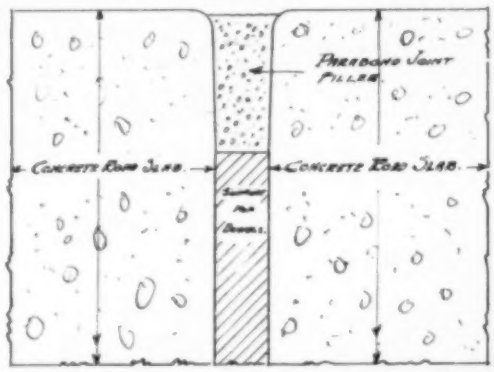
RIDGID PIPE TOOLS

CONSTRUCTION EQUIPMENT NEWS... *Continued*

OIL-BURNING "ACCORDION-TYPE" SALAMANDER for use in curing concrete in cold weather, for drying out new plaster or masonry and for keeping aggregates from freezing, has 2,000 sq. in. of heating

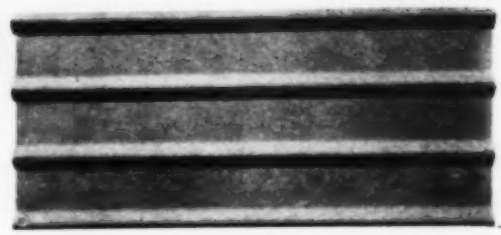
surface and develops 2,100 deg. F. flame temperature. Easily moved by one man. Provides clean, safe heat without ashes, sparks or smoke. Requires no attention or feeding. Four-gallon tank of kerosene burns 12 hr. Length, 38 in.; width, 14 in.; height, 24 in. Shipping weight, 85 lb. — **Littleford Bros., 443-57 E. Pearl St., Cincinnati, Ohio.**

LATEX RUBBER EXPANSION JOINT is sealed with compound mixed in field from three ingredients and poured in place. Mixture contains no caustic alkali (therefore is safe to handle), is transportable, stable



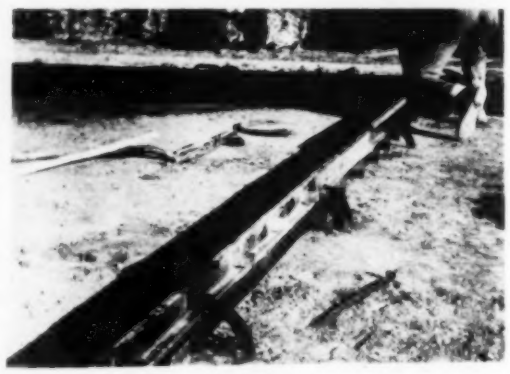
and self-bonding to clean concrete (needs no primer), and is self-vulcanizing, non-extruding and non-cracking. Joint filler is compounded to resist light and oils and is further protected against surface crazing by painting with neoprene latex compound. Joints of this type already have been in use in concrete pavement for more than 18 months. — **Parabond Corp. of America, 333 Washington St., Boston, Mass.**

ASBESTOS-CEMENT SIDING, called Trafford Tile, for siding and partitions in industrial buildings, is composition of asbestos fiber and Portland cement which makes strong, tough sheet resistant to fire and weather. Tile is gray in color, requires no protective coating and is said to become tougher and stronger with age under normal atmospheric



conditions. Corrugations increase strength and facilitate alignment in application. Asbestos-cement accessories for use with tile, such as corner rolls, are supplied, as required. Tile is produced in standard lengths from 3 to 8 ft., in areas of approximately 11 to 29 sq. ft. — **Keasbey & Mattison Co., Ambler, Pa.**

HIGHWAY EXPANSION JOINT for use in road construction has Armco "Crosslode" feature which prevents joint from offering resistance to closing when concrete expands and prohibits entry of



foreign material that might keep it open. Also designed to withstand shock of loads rolling from one slab to another across joint. These joints are said to reduce maintenance to a minimum and practically to eliminate random transverse cracks. — **American Rolling Mill Co., Middletown, Ohio.**

SIDE-BY-SIDE COMPRESSOR, 315-cu.ft. capacity, has unusually short turning radius and can easily be transported from place to place, a particular advantage to users who must move their equip-

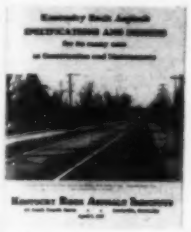
ment frequently. New trailer includes all patented Davey features of "air-cooled air," including multiple V-belt drive, is 127 in. long, 85 in. wide and 70 in. high. Streamlined frame and hood.—**Davey Compressor Co., Kent, Ohio.**

HYDRAULIC SCRAPERS are specially designed to pick up full load in record time and unload while tractor is traveling at top speed. Three hydraulic cylinders, exactly alike, with all component parts interchangeable, are required to operate unit. Rotary gear pump provides necessary hydraulic power. Outstanding feature is indicator gage mounted on top of control valve at front of scraper which gives operator positive control of depth of cut, and, when spreading, indicates height of bowl above ground. This device is said to take guesswork out of scraper operation. — **Heil Co., 3,000 W. Montana St., Milwaukee, Wis.**

NEWS FROM MANUFACTURERS *About Their Products*

The publications reviewed below, will keep you posted on latest developments in construction equipment and materials available for your use.

KENTUCKY ROCK ASPHALT — **Kentucky Rock Asphalt Institute,** 312 S. Fourth St., Louisville, Ky. (32 pp. illustrated). Describes many advantages of Kentucky Sandstone Rock Asphalt and also serves as general guide and instruction book for proper use of material. Chapters give general description and list properties of product; describe proper method of laying rock asphalt surface course; tell how to assure proper maintenance, repair and resurfacing. Diagrams of cross-sections for resurfacing with rock asphalt wearing course.



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WRENCHES — **J. H. Williams & Co.,** 75 Spring St., New York City. (28 pp. illustrated). Booklet entitled "How to Select and Use Wrenches" contains helpful information to guide both mechanic and tool buyer and includes complete tables giving correct wrench openings for U.S., S.A.E., American Standard Nut and Cap Screw sizes. Data on wrench types and their applications, well illustrated.

• • •

LEANING WHEEL GRADERS — **J. D. Adams Co.,** Indianapolis, Ind. (24 pp. illustrated). Five types of graders for heavy and moderately heavy work, power- and hand-controlled, with 8-, 10- and 12-ft. blades, and operated by tractors from 30 to 50 hp. or more, are described in this catalog. Power- and hand-operated control mechanism is explained at length as is also the new all-welded frame design which makes these models different from previous models put out by the company. Other features listed: sturdy axles, tractor-type wheels, strong and simple drawbar and circle, smooth, positive blade control, blade designed for heavy grading and positive-acting steerable tongue.

• • •

PROTECTIVE TREATMENT FOR CONCRETE — **Marvik Corp.,** Grant Bldg., Pittsburgh, Pa. (16 pp. illustrated). Portrays in graphic form uses of V-9 products especially developed to neutralize reactions causing disintegration of concrete, such as weather conditions, acids, and alkalies, oxidation, and low temperatures. Treatment comprises application by spray gun of penetrating coat and seal, or finish, coat and is said to close concrete surface to further absorption of water and to stop resultant damage. Also describes V-9 Fibrated Mastic, special waterproofing material developed to protect surfaces of concrete grain elevator tanks, bridge decks, etc.

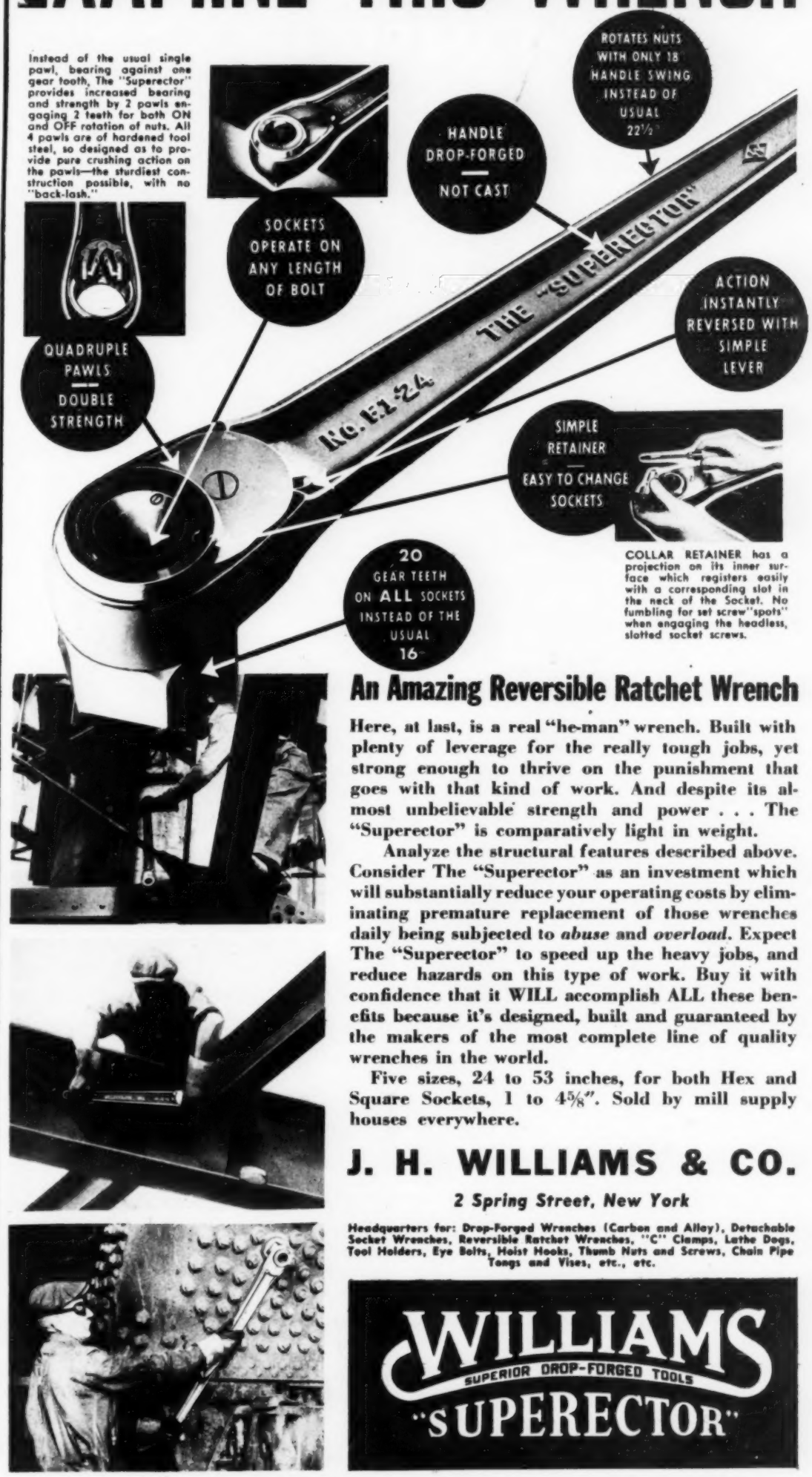
• • •

ANSWERS DUST QUESTIONS — **Mine Safety Appliances Co.,** Braddock, Thomas & Meade Sts., Pittsburgh, Pa. (16 pp. illustrated). "Pertinent Questions and Answers Concerning Dusts" is title of booklet which endeavors to answer some of the important questions which arise regarding the nature and effects of dusts, in simple and, in so far as possible, non-technical language. Copies available upon request to manufacturer.

• • •

SNOW PLOWS AND WINGS — **American Hoist and Derrick Co.,** St. Paul, Minn. (20 pp. illustrated). Describes and illustrates American line of snow fighting equipment including complete series of heavy-duty "Vee" plows, displacement, speed and general purpose types, for use on trucks of varied ratings. Three types of mouldboard plows are shown — adjustable conical, rigid conical and reversible. Specifications for center mounted wings, power-driven and hand-operated. Other equipment described; hitches, shoes, caster rollers and hydraulic hoists for use with these machines.

EXAMINE THIS WRENCH


Instead of the usual single pawl, bearing against one gear tooth, The "Superector" provides increased bearing and strength by 2 pawls engaging 2 teeth for both ON and OFF rotation of nuts. All 4 pawls are of hardened tool steel, so designed as to provide pure crushing action on the pawls—the sturdiest construction possible, with no "back-lash."
ROTATES NUTS WITH ONLY 18° HANDLE SWING INSTEAD OF USUAL 22½°
HANDLE DROP-FORGED — NOT CAST
SOCKETS OPERATE ON ANY LENGTH OF BOLT
QUADRUPLE PAWLS — DOUBLE STRENGTH
THE "SUPERECTOR"
NO. 1124
ACTION INSTANTLY REVERSED WITH SIMPLE LEVER
SIMPLE RETAINER — EASY TO CHANGE SOCKETS
20 GEAR TEETH ON ALL SOCKETS INSTEAD OF THE USUAL 16
COLLAR RETAINER has a projection on its inner surface which registers easily with a corresponding slot in the neck of the Socket. No fumbling for set screw "spots" when engaging the headless, slotted socket screws.

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Analyze the structural features described above. Consider The "Superector" as an investment which will substantially reduce your operating costs by eliminating premature replacement of those wrenches daily being subjected to *abuse* and *overload*. Expect The "Superector" to speed up the heavy jobs, and reduce hazards on this type of work. Buy it with confidence that it WILL accomplish ALL these benefits because it's designed, built and guaranteed by the makers of the most complete line of quality wrenches in the world.

Five sizes, 24 to 53 inches, for both Hex and Square Sockets, 1 to 4⅝". Sold by mill supply houses everywhere.

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"SUPERECTOR"

The Economical Road Builder

Don't let the first cost of wire rope fool you. It's the final cost that counts. And it's in the final cost that "Flex-Set" Preformed Yellow Strand always proves its economy in road building.

It's really the same Yellow Strand that contractors have learned to appreciate through many years — with this difference: The wires and strands are now *preshaped* to the helical form they occupy permanently in the finished rope.

But what a difference this makes! "Flex-Set" Preformed Yellow Strand is limp — handles and installs much easier and quicker. It splices easier, too, and is highly resistant to kinking, fatigue and drum crushing.

All this makes for long life — the long satisfactory life that means economy in road building. Try it!

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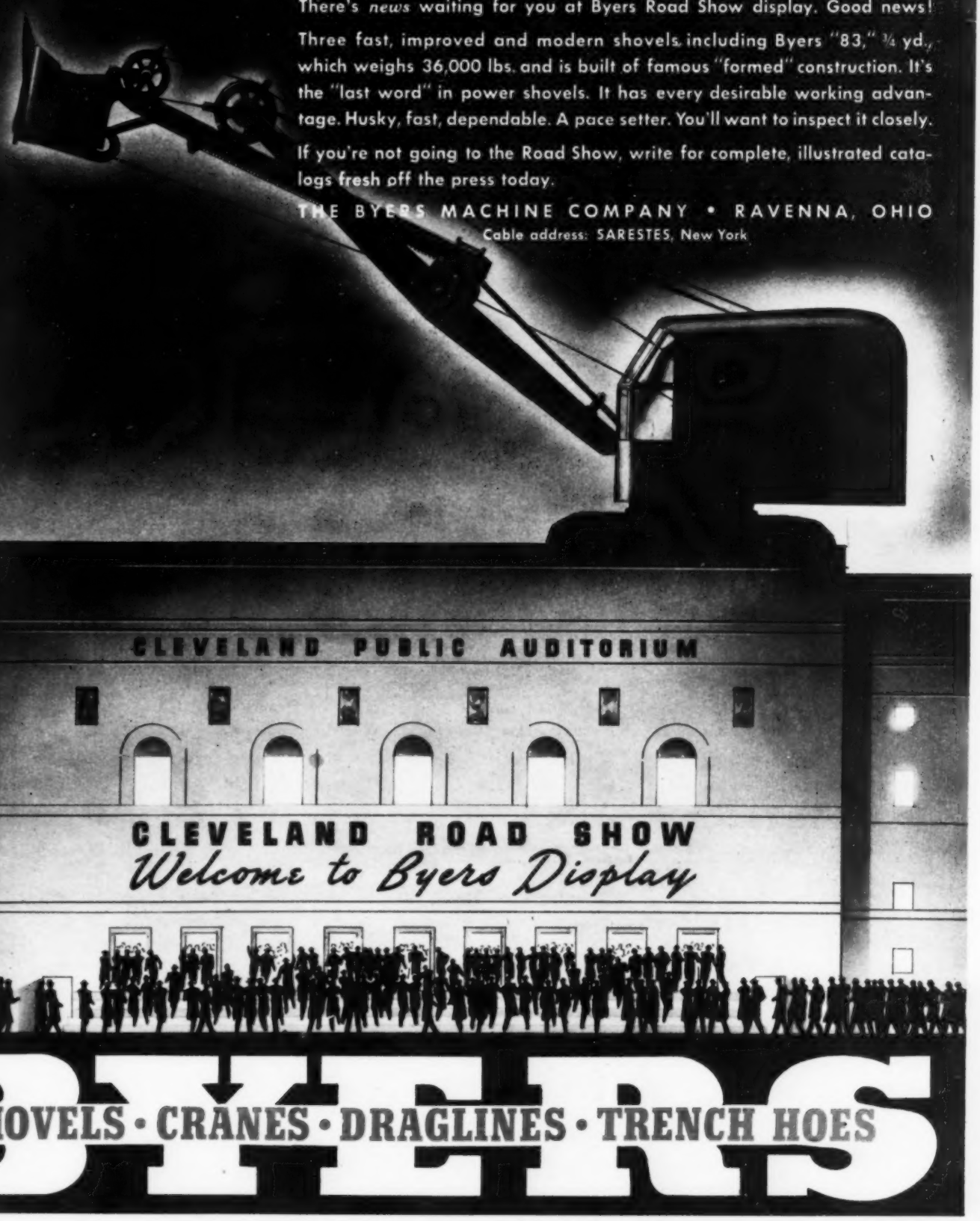

There's *news* waiting for you at Byers Road Show display. Good news!

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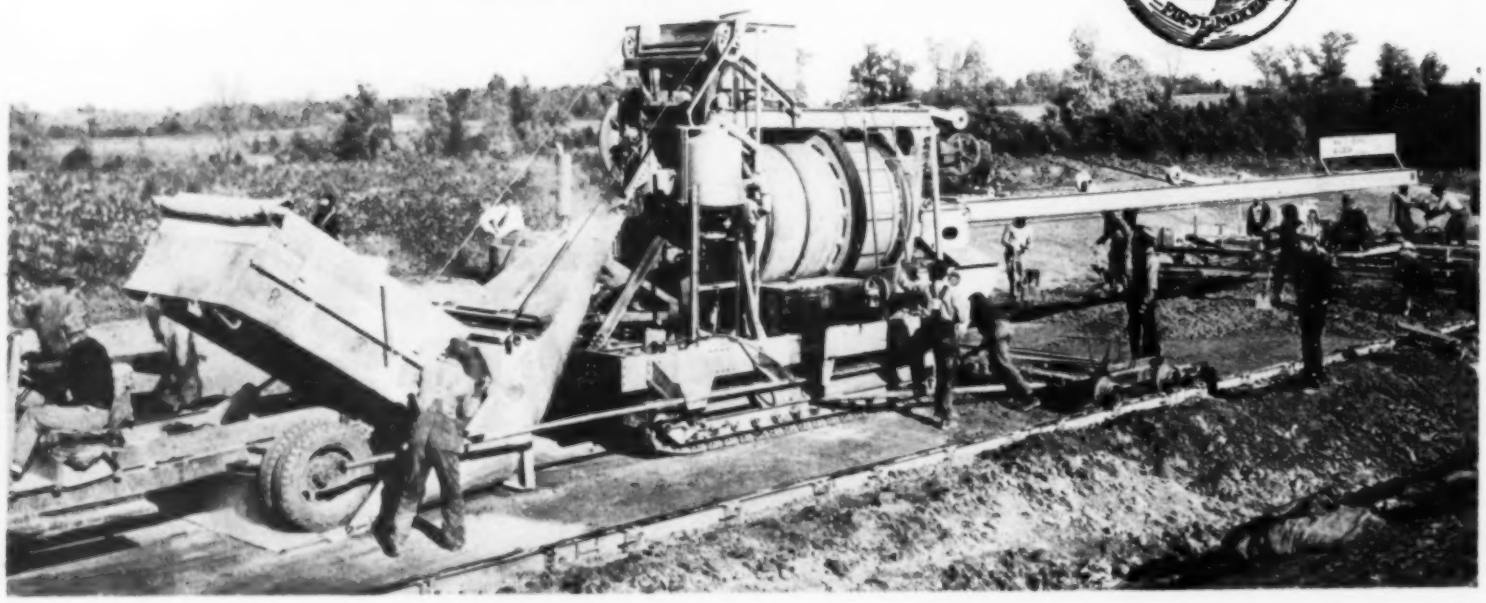
—and all the other latest advancements in Concrete Mixing Equipment . .



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Whether it's a matter of easy maneuvering or fast traveling from job to job, the P&H Model 255 has the change of pace to meet every need. With three forward speeds ranging from 3/4 to 3 miles per hour, it sets a new standard for mobility among machines in its class.

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There's a change of pace in digging, too, with 3-speed transmission to answer every demand for power whether it's soft soil or the toughest clay. It has the P&H HIGH-LEVERAGE DRIVE for smoother action and less clutch wear. The 255 has more horsepower than any other machine of its size!

SPEED—IN EARNING

Here's the speed and flexibility to handle a larger variety of work and do it at lower cost. You can bid on more jobs—get more jobs—keep your machine busier and show a better year 'round operating profit with the P&H Model 255.

P&H MODEL 255—3/4 YARD
ON DISPLAY FOR THE FIRST TIME
AT THE 5-STAR ROAD SHOW
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T SOUNDS GOOD TO ME!

And I shall be glad to get the details on this new excavator. Please send me a copy of Bulletin X-42. I understand that this obligates me in no manner whatsoever.

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Gasoline powered "Utility" Compressors.

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"Fordair Jr." Compressors on DeLuxe Trailer.

MODEL 105
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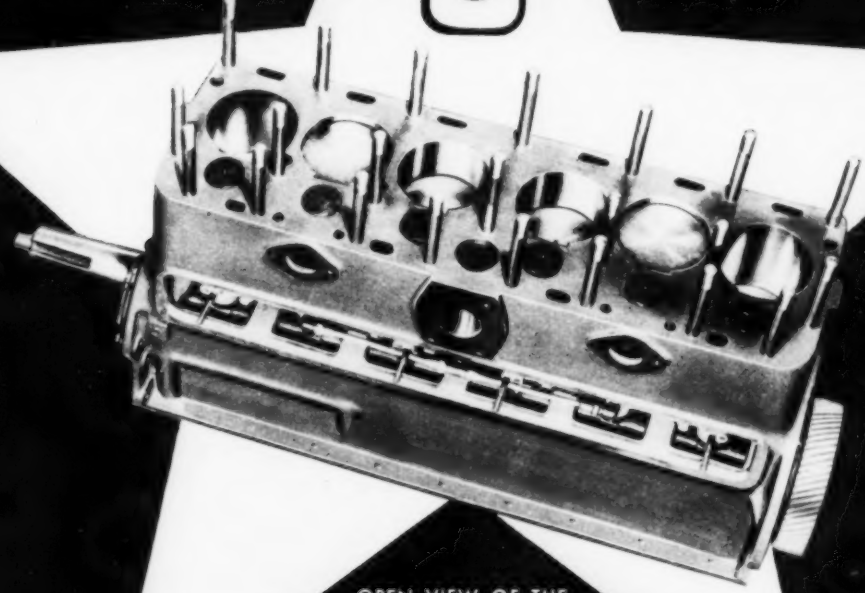
MODEL 315
Diesel powered "Utility" Compressors.

SCHRAMM'S 5 STARS



OPEN VIEW OF THE SCHRAMM "UTILITY" COMPRESSOR BLOCK

VISIT BOOTH C-5

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ROAD SHOW and CONVENTION
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NEWEST
MACHINERY - METHODS - MATERIALS
CLEVELAND, OHIO
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Five star SCHRAMM Compressors at the Cleveland Road Show . . . your opportunity to see sizes, types and features of the SCHRAMM "Utility" Compressors . . . Be sure you stop at Booth C-5!

"THE WORLD'S MOST MODERN AIR COMPRESSORS"

SCHRAMM, INC., WEST CHESTER, PENNA.

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Faster Loading • • CUTS COSTS

4 PICTURES

THAT ARE WORTH

40,000 WORDS

SOUTHWEST SCRAPERS HAVE PROVEN

TO LOAD FASTER
IN LESS DISTANCE
THAN OTHER
COMPETITIVE MAKES

Southwest Carry Type Scrapers Cut Earth-Moving Costs

Best proof of Southwest superiority comes from field tests where our Carry Type Scrapers are setting better earth-moving records. On tough jobs throughout the country users report, Southwest scrapers are loading faster and in less distance than other competitive makes. At Torrance, working in hard black adobe, the Southwest is cutting and loading to full capacity without the aid of a ripper.

Of course, this cost-cutting performance comes from years of experience in designing earth-moving equipment. The unit is sturdily constructed of alloy steel electrically welded by the "Lucas Process" of Arc Welding. The simple cable operating unit is fast, efficient, wear resisting.

SOUTHWEST
WELDING & MFG. CO., Inc.
ALAHAMBRA—CALIFORNIA

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2 **A QUICK GET AWAY**

3 **HIGH GROUND CLEARANCE MAKES EASY HAULING**

4 **CLEAN DUMPING-ACCURATE SPREADING**

SOUTHWEST
TRACTOR EQUIPMENT

25 REASONS FOR CHOOSING BAY CITY

1—Convenient economical weight.
2—Helical cut gears—noiseless, long wearing.
3—Unit (nickel-manganese) car body and machinery table, totally heat treated.
4—Anti-Friction bearings thruout.
5—6-cylinder power.
6—Extra large diameter swing roller-path
7—Oversized clutches & brakes.
8—Drop forged crawler shoes.
9—Long crawlers—low bearing pressure.
10—Chain crowd with automatic adjustment.
11—Swing lock—in any cab position.
12—Automatic Travel lock.
13—Extra heavy cab. Plenty inside working room.
14—Fast operating speeds.
15—Two travel speeds.
16—All steel construction.
17—Three lever control.
18—E-Z clutch control.
19—High pressure lubrication thruout.
20—Safety worm boom hoist.
21—Separate hoist drums.
22—Internal swing teeth.
23—Unequalled steering at full speed.
24—Convertible—without machinery change.
25—Accessibility for inspection or adjustment.

●

VISIT OUR EXHIBIT *at the* ROAD SHOW and ask about these details

●

12 Models — ⅜ to 1¼ cubic yards, also ⅜ ½ — ⅝ yd. Truck mounted shovels and cranes.

BAY CITY *design and speed insures* MORE YARDAGE

Tough hard rock handling is no task for this BAY CITY heavy duty ⅝ yard Diesel, turning out yardage records for the town of Barrington. You will find BAY CITY shovels where economy of operation and low upkeep go hand in hand with tough jobs.

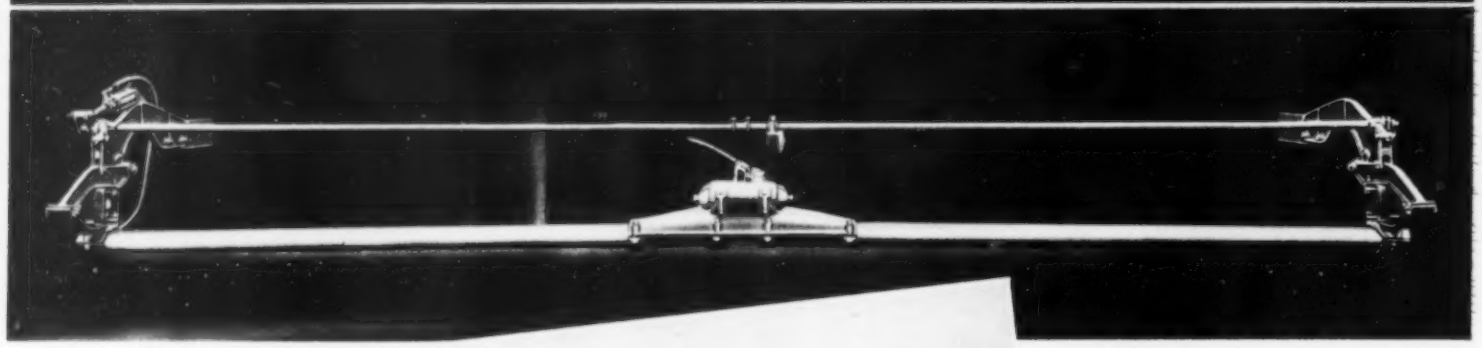
Look over the 25 Reasons and you will know why it will pay you to compare BAY CITY construction materials, design accessibility, speed, working ranges and safe load capacity with any machine in the same weight and capacity before buying your next shovel. The BAY CITY will give you yardage at low cost — they are definitely proven to be most desirable, economical and efficient in operating service.

You cannot equal BAY CITY value or performance — regardless of price.

Write for latest catalog and details.

BAY CITY SHOVELS INC. EASTERN OFFICE ROSELLE, N. J.
BAY CITY, MICHIGAN

The JACKSON VIBRATORY PAVING TUBE



Shown above is the complete Jackson Vibratory Paving Tube Assembly.

At left is an action shot of the paving tube transforming low slump concrete to a plastic, easily workable condition for perfect placement and finishing.

Here the Paving Tube is completely submerged to top of motor to make this harsh, stiff, nearly zero-stump concrete thoroughly puddled for easy handling by the finisher.

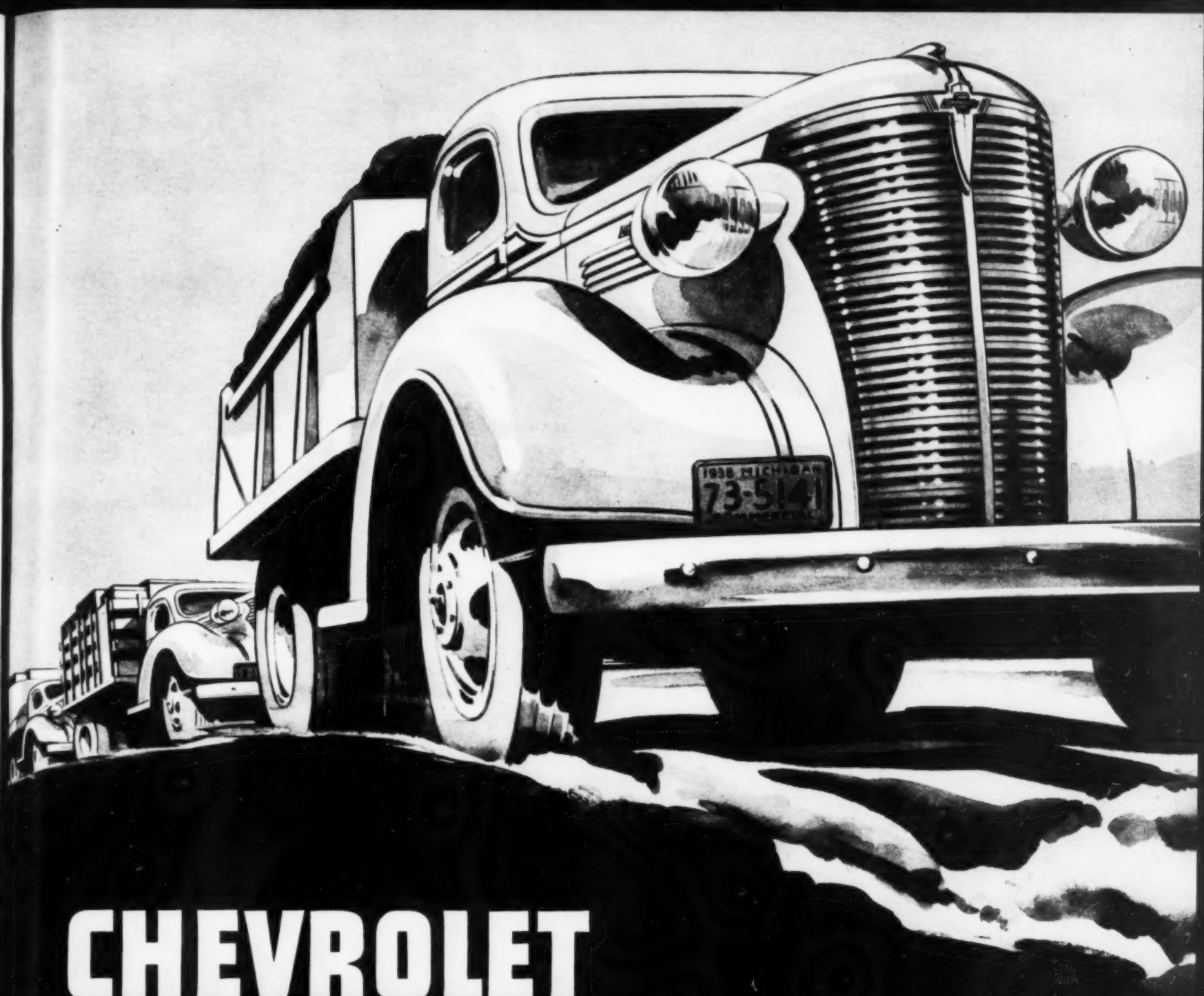
SUITABLE for any width and readily installed in the field upon any make or type of paving finisher, the JACKSON VIBRATORY PAVING TUBE accomplishes *100% internal vibration* of the concrete throughout the slab, and at the side forms and transverse joints, smoothly and uniformly . . . with harsh, dry mixes that would be impossible to handle by ordinary methods. By thus greatly extending the limits of workability, the Tube enables highway engineers to take full advantage of the W/C ratio.

Results obtained with equipment purchased by paving contractors and used under supervision of state highway departments conclusively prove the JACKSON VIBRATORY PAVING TUBE today's outstanding machine for producing a concrete paving slab of maximum strength, density and freedom from honeycomb at a substantial saving to both the state and contractor.

WRITE FOR FOLDER
CM TUBE

SEE THE TUBE at the ROAD SHOW Booth E20

Manufactured for
JACKSON VIBRATORS, Inc., LUDINGTON, MICHIGAN
by
ELECTRIC TAMPER & EQUIPMENT CO.
LUDINGTON, MICHIGAN



CHEVROLET CONSTRUCTION EQUIPMENT

On Review

A Parade of Equipment for Use in the Engineering and Construction Field, Available on the Chevrolet Truck Chassis.

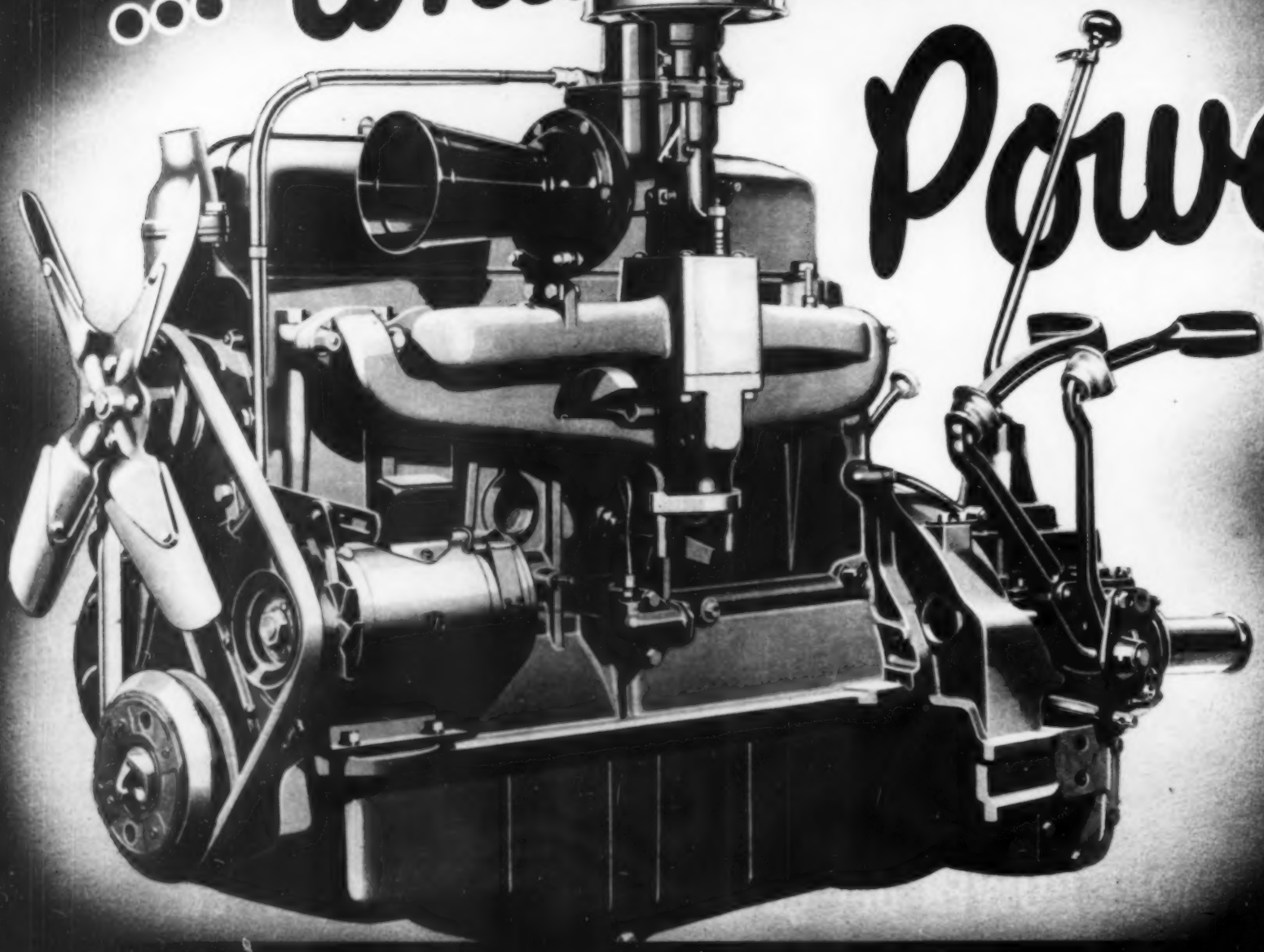
"MORE POWER per gallon—LOWER COST per load"

On every Construction P

CHEVROLET TRUCKS INCREASE PROFITS WITH THESE THREE IMPORTANT SAVINGS

Powerful, ruggedly built Chevrolet trucks have the stamina and endurance to handle the many kinds of construction haulage . . . and at outstandingly low cost! The *first saving* you make when you place fast, flexible Chevrolet units on your jobs is the low price you pay for Chevrolet trucks. The *second saving* comes from famous Chevrolet operating economy—less gas and less oil per ton-mile. And the *third saving* is the result of great Chevrolet durability—the low maintenance expense of equipment that *stays on the job* . . . and for extra thousands of miles of service! Investigate the economy of modern and dependable Chevrolet trucks and how they'll add to the profit you make on your construction jobs.

. . . and here is Power . .



THE CHEVROLET SIX-CYLINDER VALVE-IN-HEAD TRUCK ENGINE

Years of experience in the building of truck engines, plus years of research and testing by the world's most famous automotive engineering organization, have made the Chevrolet valve-in-head truck engine a modern, efficient power unit. It delivers maximum power from every drop of fuel. Every part and feature—cooling, lubrication, ignition—is precision-designed, precision-built and strongly, durably constructed, to give dependable, long-life and economical performance.

CHEVROLET

REVIEW OF CHEVROLET

---the Modern Mobile Concrete Plant

1, 1½ and 2-2½ Cu. Yd. Sizes

JAEGER TRUCK MIXERS on Chevrolet Trucks

Dual Axle 6-Wheel Mounting—for 2-2½ Yd. Units on 1½ and 2 Ton Trucks: . . .

Maximum payload with minimum equipment investment. Also solves problem of load limitations in certain states.

Whether you produce your own material or buy it ready-mixed, it pays to build with Jaeger Truck Mixed Concrete—pays in higher strength, easier workability and absence of segregation in the material, pays in lower cost of mixing plant and real job savings gained by mobile operation.

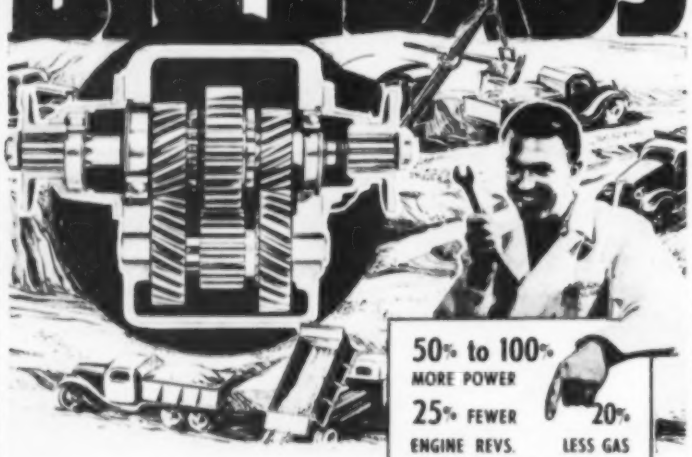
The Jaeger Dual-Mix Drum is recognized as the most efficient device on the market for mixing concrete, putty, plaster and various bituminous materials in transit. This proven higher strength of Jaeger-mixed material, plus complete mobility, the elimination of job congestion, and the ability to discharge quickly and cleanly direct into forms (with Jaeger Adaptable One-Man Chute and with Rear Lift Hoist if desired) are reasons why contractors are using 30 MILLION DOLLARS WORTH of Jaeger Truck-Mixed Concrete yearly.

Built of Man-Ten Alloy Steel (stronger, lighter), equipped with Dual Mixing Speeds and 3-Point Mounting, giving low center of gravity with weight well forward of rear truck axle—Jaeger Truck Mixers enjoy the lowest maintenance costs in the industry on truck mixers, trucks and tires. The same trucks that carry mixers may also be used for other purposes—units clamp on chassis and may easily be removed and replaced by dump bodies. Powered by separate engine or direct truck engine drive.

Our experience, as world's largest builder of Truck Mixers for ready-mix plants and contractors on construction work, road widening, paving, sewers, curb and gutter and many special jobs, is at your service. Write for a copy of our new SPECIFICATION TM-37—the most complete book of Truck Mixer data ever published.

THE JAEGER MACHINE CO., 800 Dublin Ave., COLUMBUS, OHIO

BIG LOADS



50% to 100% MORE POWER

25% FEWER ENGINE REVS.

20% LESS GAS

Haul bigger loads, make more trips, move more material with a Watson-Brown-Lipe Auxiliary Transmission in your truck. Compound low gears for quick and easy starting of big loads . . . compound split gears for fast handling of big loads . . . compound high gears for fast return trips empty. No more bucking, no more frogging, no engine lugging, no engine racing. Better performance all around. Ask contractors who use them . . . they'll tell you! There's nothing like a Watson-Brown-Lipe.

DISTRIBUTORS IN PRINCIPAL CITIES

FAST TRIPS

12 FORWARD SPEEDS 3 REVERSE

AUXILIARY Transmissions

ASK FOR CATALOG

WATSON-BROWN-LIPE

N.S. WATSON CO., SAN FRANCISCO & TOLEDO

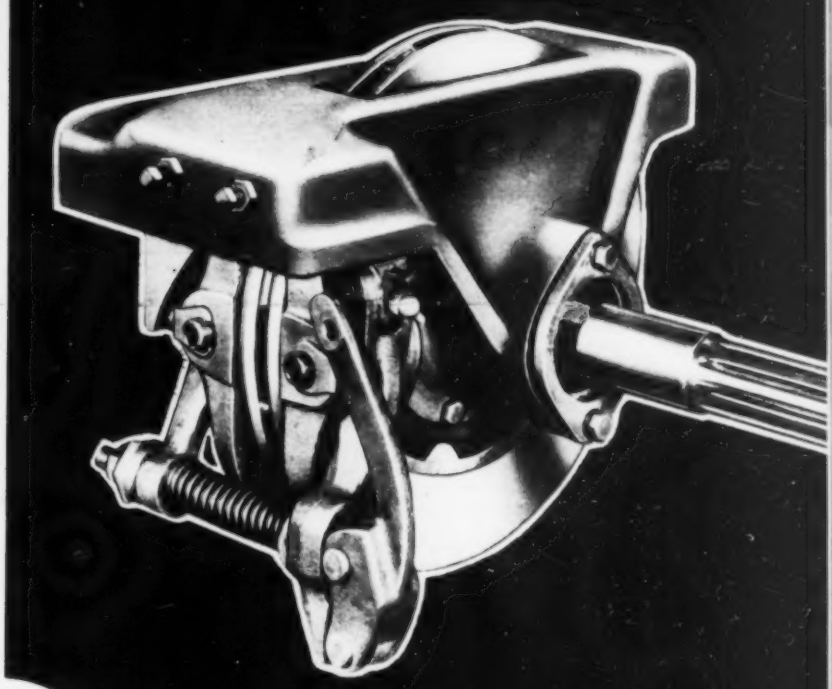
C-33

When your dogs get tired from tramping around the Road Show at the Cleveland Auditorium drop into a comfortable chair at point C-33 and look over the Road Builders' Number of *Construction Methods & Equipment* and the Highway Number of *Engineering News-Record*.

C-33

CONSTRUCTION EQUIPMENT

CHEVROLET



ACCO

TRU-LEVEL OIL CONTROLLER

● The TRU-LEVEL OIL CONTROLLER automatically maintains full crankcase, keeps oil at correct temperature, insures most efficient motor lubrication at all times. A fresh supply of oil flows from the reservoir through a tube into crankcase as soon as crankcase falls below correct level. Prevents overheating, oil breakdown, excessive motor wear caused by too *little* oil. Ends fouled spark plugs, carbonization, sticky valves due to too *much* oil. Quickly pays for itself in oil savings and reduced maintenance costs. Easily, quickly mounted on the motor side of dash or directly on motor. Made in two sizes—1 GALLON capacity for passenger cars, taxicabs, light trucks and buses on short runs; 3 GALLON capacity for heavy trucks and buses on long runs. Write for complete particulars.

A FEW OF THE AMERICAN CHAIN & CABLE AUTOMOTIVE PRODUCTS

AMERICAN CABLE DIVISION
Tru-Lay Brake Controls • Push-Pull Controls
Tru-Stop Brakes

AMERICAN CHAIN DIVISION
Weed Tire Chains • Emergency Units
Weed American Bar-Reinforced Tire Chains
Weed Bull Farm Tractor Chains

MANLEY MANUFACTURING DIVISION
Service Station Equipment

OWEN SILENT SPRING COMPANY
Owen Cushion Spring Centers

PAGE STEEL AND WIRE DIVISION
Welding Wire

WRIGHT MANUFACTURING DIVISION
Chain Hoists and Cranes

TRU-STOP EMERGENCY BRAKE

● These powerful, dependable emergency brakes provide added safety and "stop-ability"—more than meet the requirements of the most stringent state laws. They will quickly stop a heavily loaded vehicle with smooth, positive gripping action—no chattering or grabbing. Brake pressure is in direct proportion to driver's pressure on the brake lever and is distributed evenly over entire lining surface. Self cooling Ventilated Disc prevents overheating when braking and keeps lining cool, thus assuring longer service life. Any mechanic can easily install Tru-Stop Emergency Brakes—any driver can adjust or reline them in a few minutes.

AMERICAN CHAIN & CABLE COMPANY, Inc.

12-252 GENERAL MOTORS BLDG., DETROIT • 630 THIRD ST., SAN FRANCISCO

TRUCKSTELL conversions

for EXCEPTIONALLY HEAVY DUTY SERVICE

CHEVROLET TRUCKSTELL CONVERSIONS are built in models for all hauling that cannot be advantageously handled by standard Chevrolet Trucks.

Each has different characteristics and a clearly defined purpose which it fulfills with exceptional efficiency.

In all models, the reserve power of the Chevrolet engine is utilized in connection with the proper size of Eaton 2-speed Axle and other well balanced units of proven design.

The rated capacity of each model is based conservatively upon heavier frame, larger tires, oversize springs, stronger drive members and more powerful brakes.

As a result, Truckstell Trucks outperform and outpull all other trucks of similar rated capacities; yet they are priced well under such trucks through the use of standard units produced in vast quantities.

Truckstell Trucks are built to controlled specifications by licensed manufacturers located in principal cities and sold only through authorized Chevrolet dealers.

Models are available with ratings from 2½ to 10 tons in wheelbases to accommodate bodies of all types and sizes.

EMBODYING THESE PROVEN UNITS

THE STANDARD CHEVROLET MOTOR AND SYNCRO TRANSMISSION
Efficient service and low gasoline consumption in the world.

EATON 2-SPEED AXLES
6 forward speeds and 2 reverse speeds. Power and speed in a single unit. Better and more economical service under all conditions.

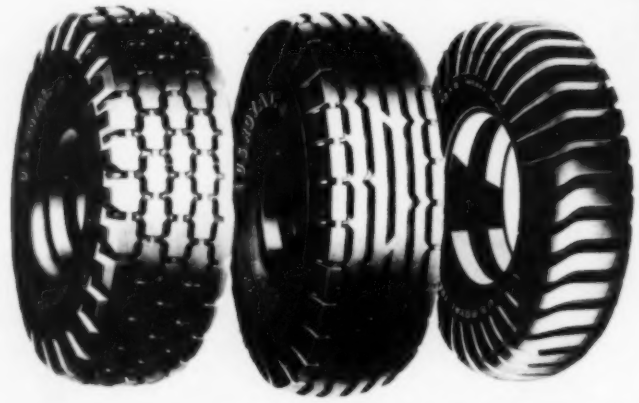
B-K VACUUM POWER BRAKES
Assure dependable uniformly quick action in keeping with the greater power and size.

GENERAL HEAVY DUTY TIRES
Assure the utmost in long, dependable service.

TRUCKSTELL Inc.
CLEVELAND · · · OHIO

U. S. TIRES

...Specialized Types For Construction Work



U. S. ROYAL HEAVY SERVICE
A rugged heavy duty truck tire available in balloon or high pressure types for all normal operating needs.

U. S. ROYAL FLEETWAY
A streamlined tire for speed hauling — runs cooler — wears longer.

U. S. ROYAL SPECIAL SERVICE
For road building, grading and other jobs requiring maximum pulling power.

"U.S." builds a complete line of specialized truck tires for the Chevrolet . . . each designed with the special features that deliver utmost economy on the specific job.

United States Rubber Products, Inc.

United States Rubber Company
NEW YORK • DETROIT • LOS ANGELES

A 20-page, 3-color presentation of Chevrolet Trucks and Auxiliary Construction Equipment.

Designed in terms of the construction man's specific interests through the cooperation of 14 manufacturers.

Commercial Car Dept.,
Chevrolet Motor Division
General Motors Sales Corp.,
Detroit, Michigan

Please send me without obligation the 20-page review of Chevrolet Construction Equipment.

Name ..... Title .....

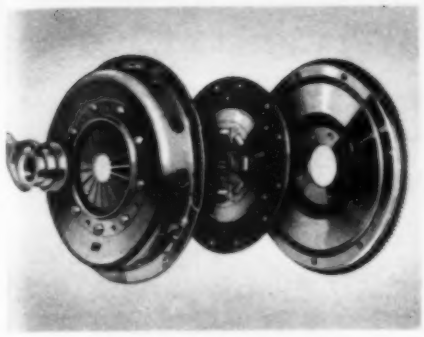
Company .....

Address .....

.....

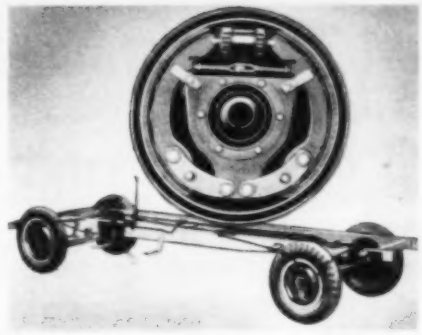
IT COSTS NOTHING EXCEPT THE POSTAGE STAMP IT TAKES TO MAIL THIS COUPON.

CHEVROLET CHASSIS FEATURES *for Construction Service*



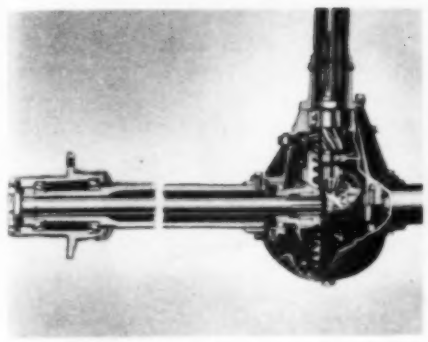
NEW DIAPHRAGM SPRING CLUTCH

A clutch of revolutionary design—combining light weight and durable strength; giving a new degree of smooth, positive action, and adding greatly to performance ability.



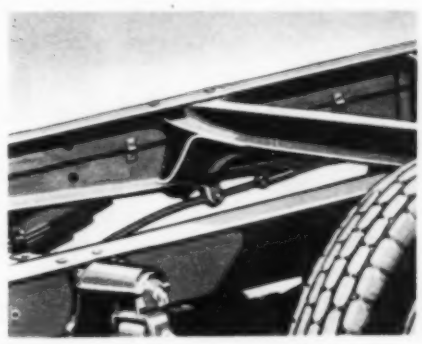
PERFECTED HYDRAULIC TRUCK BRAKES

Powerful, positive-action brakes that provide identical pressure to each brake drum. They have advantages of safety and economy of maintenance not possessed by other types.



FULL-FLOATING REAR AXLE

The entire load weight is carried on the wheels. The ruggedly built axle is thereby unrestricted in its function of delivering driving power to the wheels.



RIGID "ALLIGATOR JAW" FRAME

The Chevrolet truck frame is a model of strength and durability—the kind of strength needed to meet the demands of construction haulage.

SPECIFICATIONS

ENGINE

Six-cylinder valve-in-head—3½″ bore and 3¾″ stroke. Taxable horsepower, 29.4. Brake horsepower, 78 at 3200 r.p.m. (85 horsepower at 3200 r.p.m. in Coupe Pick-up). Rated torque capacity, 170 foot-pounds at 850 to 1550 r.p.m. (900-2000 r.p.m. in Coupe Pick-up.)

(a) *Crankcase and Cylinder Block*—Cylinder block cast en bloc (including upper half of crankcase); head detachable.
(b) *Crankshaft*—Drop-forged steel, heat-treated, 4 main bearings.
(c) *Camshaft*—Drop-forged steel, case-hardened, four bearings.
(d) *Connecting Rods*—Drop-forged steel, heat-treated; 6 11/16″ long, center to center.
(e) *Lubrication*—Combination direct pressure, pressure stream and splash system. Gear-type oil pump.
(f) *Cooling*—Centrifugal water pump, 4-blade fan. Water capacity, 14 quarts.
(g) *Carburetion*—Specially designed, 1¼″ Carter downdraft carburetor.
(h) *Air Cleaner and Flame Arrester*—AC type.
(i) *Ignition*—Delco-Remy. Octane Selector.
(j) *Generator*—Delco-Remy.
(k) *Starting Motor*—Delco-Remy.
(l) *Engine Suspension*—Rubber mountings.
(m) *Piston*—Slipper type—tin-plated cast-iron. 3 rings above pin—pin bosses are bronze-bushed.
(n) *Valves*—Intake, 1 41/64″; exhaust, 1 13/64″, outside diameter.
(o) *Crankcase Breather*—Fumes are exhausted by a suction tube to the outside of under-pan.

RADIATOR—Harrison ribbed cellular core.

GROSS ALLOWABLE WEIGHTS

(including chassis, cab, body, driver and payload)

Half-ton—6.00-16, 4 ply tires.....4400 lb.
Half-ton—15″, 6 ply tires.....4600 lb.
¾-ton—15″, 6 ply tires.....5200 lb.
1-ton—7.00-17, 6 ply tires.....5800 lb.

1½-ton (131½″, 157″ wheelbases)			
Rear Wheels	Rear Tires	Gross Weight	With Helper Springs
Single	32x6, 8 ply	7600 lb.	
Dual	6.00-20, 6 ply	9300 lb.	
Dual	32x6, 10 ply		11,300 lb.*
Dual	7.50-20, 8 ply		11,300 lb.*

*13,300 lb. with governor limiting speed to 45 m.p.h., and front tires 6.50-20, 6 ply, or larger.

	Coupe Pick-up	Half-Ton	¾-Ton	1-Ton	1½-Ton	1½-Ton
Wheelbase	112¾″	112″	122¼″	122¼″	131½″	157″
Back of cab to center line of rear axle		38¼″	48½″	48½″	57¾″	83¼″
Center line of rear axle to end of frame		38¼″	38¼″	38¼″	34⅜″	34⅜″
Back of cab to end of frame		76½″	86¾″	86¾″	92⅛″	118⅛″
Turning radius	20′	19.5′	21′	21′	25.5′	30.5′
Approximate chassis shipping weights in pounds — Single wheels	2945 (Complete Car)	2200	2420	2575	3035	3055
Approximate chassis shipping weights in pounds — Dual wheels					3120	3195
Approximate chassis shipping weights in pounds — With cab, single wheels		2580	2785	2950	3410	3415
Approximate chassis shipping weights in pounds — With cab, dual wheels					3485	3560
Clutch — Disc	9″	9″	10¾″	10¾″	10¾″	10¾″
Clutch — Type	Dry single-plate, completely enclosed. Diaphragm type spring.					
Transmission	Selective Syncro-Mesh type, 3 speeds forward, 1 reverse. 4-speed transmission available on these models at extra cost.				Selective sliding gear, 4 speeds forward, 1 reverse.	
Propeller Shaft	Tubular steel with solid ends.		Coupling shaft connects transmission and propeller shaft with heavy-duty truck universal joints. Also allows for power take-off on 1½-ton trucks.			
Universal Joints	Yoke and ring type.		All-metal type, drop-forged steel yokes.			
Steering Gear	Semi-reversible, worm and roller.	Semi-reversible, roller bearing worm and straddle-mounted sector type. 17″ steering wheel.				
Frame	4½″ deep, 3⅛″ flanges, ¼″ box-section, 4 cross-members	5¾″ deep, 2¼″ flanges, ¼″ channel, 5 cross-members	5 11/16″ deep, 2⅝″ flanges, ¼″ channel, 5 cross-members		7″ deep, 2⅝″ flanges, ¼″ channel	
Frame					5 cross-members	6 cross-members
Front Spring	Semi-elliptic, 36″ long, 1¾″ wide, 9 leaves	Semi-elliptic, 36″ long, 1¾″ wide, 8 leaves			Semi-elliptic, 36″ long, 1¾″ wide, 9 leaves	
Rear Springs	Semi-elliptic, 49″ long, 1¾″ wide, 8 leaves	Semi-elliptic, 54½″ long, 1¾″ wide, 8 leaves	Semi-elliptic, 45″ long, 2″ wide		Semi-elliptic, 45″ long, 2½″ wide, 10 leaves. Special soft-riding springs, 8 leaves. Standard on 131½″ w.b. Panel.	
Rear Springs			8 leaves	9 leaves		
Front Axle	Drop-forged, heat-treated "I" beam. New Departure ball bearings in wheels.				Heavy-duty drop-forged "I" beam.	
Rear Axle	Hypoid semi-floating	Semi-floating, spiral bevel gear, 4.111 to 1.	One-piece tubular steel house.		Full-floating, 4-pinion differential, straddle-mounted pinion. One-piece seamless steel housing.	
Brakes	Hydraulic service brakes, front and rear, double-articulated shoe, internal-expanding. Mechanical emergency brakes cut in on rear wheels.					
Brakes	11″ drums, front and rear, 1¾″ lining.			11″ front drum, 14″ rear drum	14″ front drums, 16″ rear drums, 2″ front lining, 3″ rear lining.	
Wheels	Short-spoke steel disc, integral drop-center rims.			Pierced disc lock ring rim.	Heavy dual-type pressed steel wheels—lock ring rim.	
Fuel Tank	18 gallon	16 gallon, 18 gal. in cab	18 gallon, filler outside on right-hand side of truck.			

The right is reserved to change specifications, colors or prices without incurring any responsibility with regard to trucks or chassis previously sold. Chevrolet trucks can be purchased on the General Motors Instalment Plan—convenient, economical monthly payments. A General Motors Value. Accessories on all trucks and spare tires on 1½-ton models are at extra cost.

CHEVROLET MOTOR DIVISION, *General Motors Sales Corporation*, DETROIT, MICHIGAN

INSTALL
BETTER SUBSTRUCTURES
at a Big Saving with
UNION METAL PILE SHELLS

● Dependability, speed, economy—you get all three when you use Union Metal Fluted Steel Pile Shells for tapered cast-in-place concrete piles. That's why each succeeding year finds an ever-increasing number of highway engineers and contractors adopting this tested method of pile construction. State Highway Departments of New York, Pennsylvania, Rhode Island, Florida, Ohio, California and others approve this piling.

Union Metal Pile Shells are fabricated by the cold rolling process which makes possible light weight construction without sacrifice of strength. Their fluted design not only offers increased skin frictional area for greater bearing value but provides added stiffness and rigidity.

Union Metal Shells are easily handled without the aid of costly unloading rigs; require no core or mandrel; can be driven by any contractor with ordinary crane, leads, and standard steam hammer. And lastly, but equally important, Union Metal Shells can be quickly inspected by lowering a light into their interior prior to filling with concrete.

Whether you are an engineer or contractor, you can profit in 1938 with the use of Union Metal Pile Shells. Write today for illustrated catalog containing complete specifications and installation data.

THE UNION METAL MANUFACTURING CO. • Canton, Ohio

Don't Miss the Union Metal Exhibit at the Road Show!

SPACE No. E-56

"THAT NEW SMALL SMITH MIXER IS JUST WHAT I'VE ALWAYS WANTED. A BRAND NEW IDEA, BUT IT WORKS PERFECTLY."

"OH BOY! THAT MACHINE SURE IS NEW AND DIFFERENT. IT WILL REVOLUTIONIZE METHODS IN OUR READY-MIXED CONCRETE INDUSTRY."

"YOU GOT TO HAND IT TO SMITH. FOR POURING CONCRETE OVER LARGE AREAS THEY HAVE A COMBINATION THERE THAT JUST CAN'T BE BEAT."

3 BRAND NEW concrete mixers . . . revolutionary in design, never before shown at any convention, national, state or local — will be exhibited by Smith at the

CLEVELAND ROAD SHOW

JANUARY 17 to 22, 1938

Again Smith forges ahead with the very latest developments in the mixer field . . . new advanced models with every modern refinement and backed by Smith's 38 years leadership in the industry. Be sure to see these faster, ultra-modern mixers at the Show. Or, if you are unable to attend, write for literature.

●

You are also cordially invited to visit the T. L. Smith exhibit at the National Sand & Gravel and Ready-Mixed Concrete Exposition, Cincinnati (January 31 to February 3, inclusive) and at the Concrete Industries Exposition, Chicago (February 8 to February 11, inclusive).

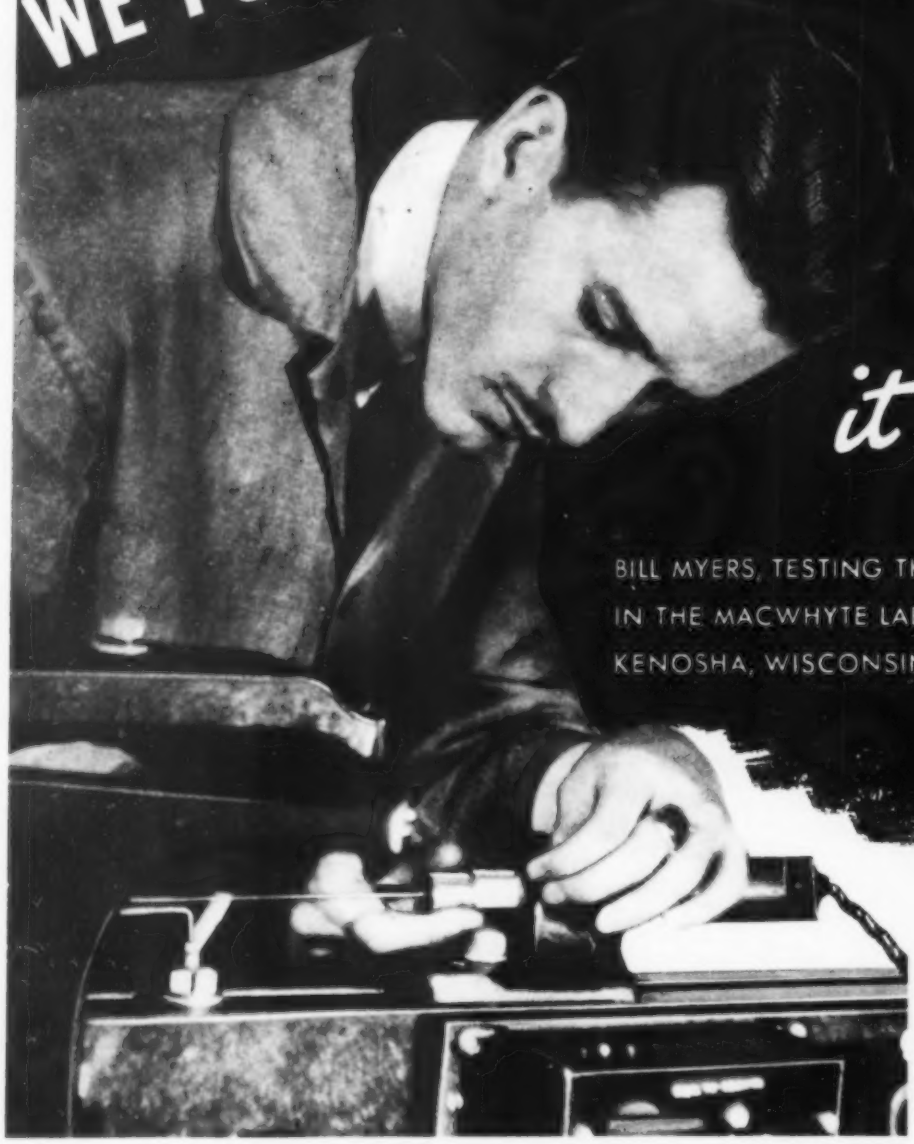
THE T. L. SMITH COMPANY
2851 N. 32nd STREET • MILWAUKEE, WIS., U. S. A.

SMITH MIXERS

THE BOULDER DAM MIXERS

WE PUNISH A WIRE TEN MILLION TIMES

..and still it won't BREAK



BILL MYERS, TESTING THE FATIGUE LIFE OF WIRE
IN THE MACWHYTE LABORATORY,
KENOSHA, WISCONSIN

"That sounds like a lot of punishment," says Bill Myers—Macwhyte Metallurgist—"but this Haigh Robertson Fatigue Testing Machine actually rotates the wire, and through this rotation, subjects the wire to bending stresses. These bending stresses are repeated 10,000,000 times without failure of the wire. Then we're sure the wire will really resist fatigue on your job.

"Fatigue has always been one of wire rope's worst enemies. Every time a rope passes over pulleys, or twists, or when it's coiled on a drum, a condition of fatigue is set up. Fatigue can actually fracture some of the wires in a rope even when the breaking strength hasn't been reached.

"We've made a lot of progress in checking fatigue here at Macwhyte. By constant testing and experimenting we've found out how to make wire with the highest possible fatigue resisting properties. *That* means when you buy Whyte Strand PREformed, you get a wire rope that gives the best of service."

LOOK FOR THE
Whyte Strand

MACWHYTE
WHYTE STRAND
IS *BETTER*
BECAUSE IT'S MADE
BY SPECIALISTS

MACWHYTE COMPANY
KENOSHA, WISCONSIN
Manufacturers of wire rope and braided wire rope slings. Distributors and stock throughout the U. S. A. for quick service.

MACWHYTE
Whyte Strand – PREformed
THE WIRE ROPE WITH THE INTERNAL LUBRICATION

Step Over
TO THE PROFIT SIDE
with
HELTZEL *Long-Life* EQUIPMENT

Can you erect a 150 ton Batching Plant in 6½ hours . . . use it as an Asphalt Plant . . . convert it to a 2—3 or 4 compartment bin without making any alterations or additions to your weighing equipment?

Heltzel equipped Contractors and Construction Engineers do these and many other time saving—profit making—conversions as an everyday occurrence.

They set and line up curb, curb-and-gutter and sidewalk forms without those seemingly endless delays for adjustments and distortion. Even after 5 years of continuous hard use Heltzel Improved Utility Forms and Heltzel Superior Type Steel Road Forms set and line as easily as new ones.

Send today for illustrated, concrete examples of how YOUR competitors got on the profit side and why they finish their projects weeks ahead of schedule. Or — step over to Sections C-35 and C-36 while you're at the Road Show and let us demonstrate how Heltzel-Built Equipment will run YOUR profits up.

Large capacity Heltzel Portable Bin being used as an Asphalt Plant.

Heltzel Standard Yoke Type Curb Forms for constructing Heavy Battered Curbs.

Left:—Heltzel Superior Type Road Forms are easier and cheaper to set.

THE HELTZEL STEEL FORM & IRON CO.
WARREN—OHIO

See G&R PUMPS at the ... ROAD SHOW

G & R SELF-PRIMING CENTRIFUGAL

When you KNOW what these simple, ruggedly built, self-priming centrifugals ACTUALLY WILL DO ON THE JOB, you can forget all the *claims* that may be made for any pump. Here will be your chance to check performance. See the pump, ask all the questions you care to, and *watch* how quickly it primes. Get the FACTS at the Road Show.

G & R TRIPLEX ROAD PUMPS

The pump you need today for long distance, large volume pumping on concrete road construction is here — with a record of perfect performance on many of the big jobs that attracted attention in 1937 because of the modern methods used. Capacities to 125 G.P.M. Pressures to 600 lbs. Built for continuous, trouble free operation and low operating cost. Be sure to see it.

Space **E-19**
Exhibition Hall

•

WATCH THE LIGHTHOUSE
SHOW THE FACTS ON
Priming Speed

THE GORMAN-RUPP COMPANY **MANSFIELD, OHIO**

FOR 1938

1938 "FLEX-PLANE" Finishing Machines will have outstanding improvements: Outboard crank pin drive and cushioned wrist pin — screed placed 7" closer to frame — screed starter springs — 30 H. P. engine takeoff for driving generator where electric vibrator is used — general all-round betterments.

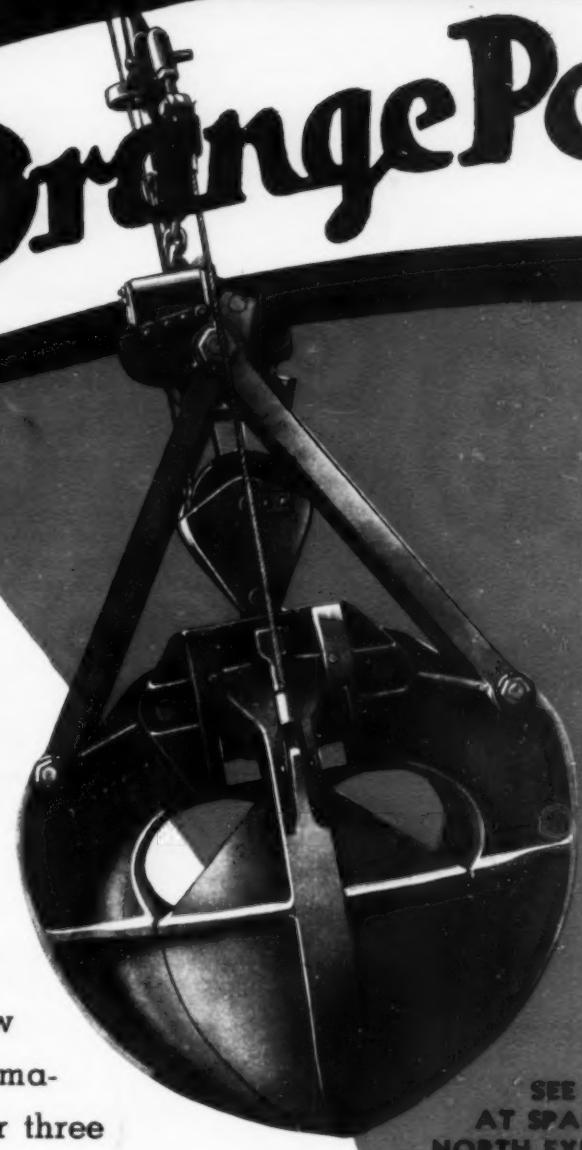
AT THE ROAD SHOW—SPACES C35 and C36

FLEXIBLE ROAD JOINT MACHINE COMPANY

WARREN **OHIO**

At the **CLEVELAND ROAD SHOW** *Booth D11*

SEE the NEW Owen Orange Peel



An original mechanical principle, thoroughly proven in practice, gives this new combination orange peel bucket and grapple greater digging ability and also greater gripping power.

See it at the Road Show. Also see a model in operation showing the independent action of its jaws. Visualize how the jaw meeting the least resistance digs deeply into the material and anchors—to be likewise followed by the other three jaws.

Picture all four jaws tightly gripping a large rock, regardless of the irregularity of its shape, or filled to capacity with numerous small rocks.

SEE US AT SPACE D-11 NORTH EXHIBIT HALL

We invite your inspection of these new OWEN products at the Road Show. Models of OWEN Type "RA" and Type "H" rock grapples will also be on display. Visit the OWEN exhibit or write for the new OWEN literature.

These Too Should Interest YOU!

THE NEW LIGHT TYPE "S" BUCKET

Designed for maximum capacity with minimum weight, by utilizing alloy steels and a light welded steel counterweight, the new OWEN Type "S" fills the need for a stronger light type bucket to produce bigger pay loads in the material-handling field.

THE NEW TYPE "DX" EXTRA-HEAVY ROUND NOSE BUCKET

A bucket designed for exceptional strength and greater digging ability. The centers of the lips on the round nose bucket penetrate the material with minimum resistance and these curved lips continue to carve their way deeply into the material, assuring greater loads at each grab. See this stronger round nose construction with no corners or square back plates to retard the entrance or cause crowding of material.

THE OWEN BUCKET CO.

6020 Breakwater Ave. CLEVELAND, OHIO

Branches: New York, Chicago, Philadelphia, Berkeley, Cal.

THERE'S NOTHING LIKE EXPERIENCE

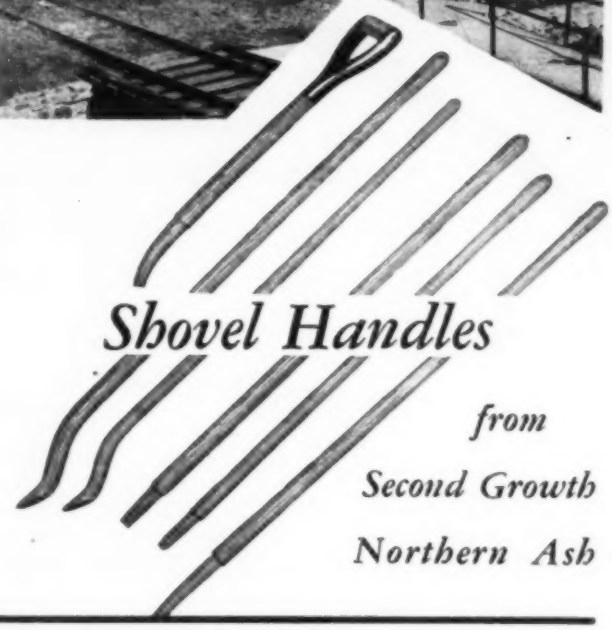
One of the five Handle Plants owned and operated by the Ames Baldwin Wyoming Co., where thousands of Northern Ash logs are made into Shovel Handles for the famous ABW Shovels. Here the famous Ames Bend is made—often imitated but never equalled.

"I've been using ABW Shovels for a good many years and I've noticed that the handle lasts almost as long as the shovel. Of course once in a while one will break, but all in all they are the toughest handles I ever saw.

"They tell me that ABW has five plants where they make nothing but handles and I suppose if the logs used each year were laid end to end they'd reach around the world more than once. Have you ever tried to break an ABW Handle? Well try it an' you'll see for yourself how tough it is.

"They also tell me they got more inspectors cruising around the woods selecting fine Second Growth Northern Ash, than you could shake a stick at. Well they sure know their business, 'cause ABW handles are the best I've ever seen."

Yes, from years of experience, ABW Inspectors know how to select the choicest of Northern Ash and the five ABW Handle plants have learned how to produce in design, toughness and finish, the world's finest shovel handles.



Shovel Handles

from

Second Growth

Northern Ash

AMES BALDWIN WYOMING CO.

PARKERSBURG, W.VA. NORTH EASTON, MASS.

SHOVELS . . . SPADES . . . SCOOPS
FORKS . . . HOES . . . RAKES
POST HOLE DIGGERS
AGRICULTURAL HANDLES

SINCE 1774

DRAG LINE ON WHEELS

Serving scattered jobs from scattered sources of supply called for this high-speed MICHIGAN TRUCK DRAGLINE, which has reduced unproductive time between locations, and is loading more trucks per day. Besides cutting operating costs, this MICHIGAN has increased operator efficiency by eliminating fatigue. . . MICHIGAN Accessory Equipment gives owners several machines in one- - DRAGLINE, SHOVEL, CRANE, CLAM and TRENCH-HOE- at minimum cost!

MAKE YOUR SMALL JOBS PAY AND YOUR BIG JOBS PAY MORE

MICHIGAN "Write for Bulletin "CM"

POWER SHOVEL CO. Benton Harbor, Mich.

See the BLAW-KNOX HIT* Parade at the ROAD SHOW

*Road Forms

*Road Finishers

*Batcherplants

*Weighing Batchers

*Bulk Cement Plants

*Trukmixers
and Agitators

*Clamshell Buckets

*Concrete Buckets

*Steel Street Forms

*Bridge Decking

*Central Mixing Plants

*Ready Mixed Plants

*Steel Forms
for General Construction

CLEVELAND PUBLIC AUDITORIUM
JANUARY 17-21, 1938

—an "in the flesh" exhibit of the complete Blaw-Knox Line—IMPROVED to save more and more money for Contractors.

Visit Booth B-9

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
2086 Farmers Bank Building Pittsburgh, Pa.
Offices and Representatives in Principal Cities

The NEW BIG STARS

SEE THEM IN CLEVELAND—JAN. 17-21!

Dominating the Road Show! The Rex Exhibit will be the center of attraction, with contractors, engineers and road builders flocking to see the new 34-E Rex Dual Drum Paver—the streamlined paver that will make paving machinery history. It's NEW—from its charging skip to its distributing bucket! It's faster, bigger, more completely self-operating than any paver ever built! It is *the* paver for 1938!

The road show premier of the Rex 160! See the concrete pump that in eight short months has set performance records never before approached by any placement method—the new portable 160 Pumpcrete! Introduced only last June, it has been used by many contractors in building viaducts, culverts, bridges, overpasses, warehouses and homes. Its adaptability to any job setup is now proved by facts—and known to contractors from Maine to California!

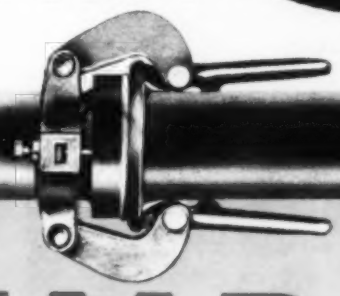
REX PAVER

CHAIN BELT COMPANY

OF THE ROAD SHOW!

THE NEW
LOW-COST CONCRETE PUMP!

PROCESS
GIESE
SYSTEM
KOOYMAN



REX PUMPCRETE
OF MILWAUKEE

These Buckeye MACHINES ARE EXACTLY WHAT YOU NEED FOR 1938 ROAD WORK PROFITS

Clipper

EXCAVATOR with METERED VACUUM CONTROL

Assures instant response through finger tip pressure, taking shovel operation out of manual labor field. Correct design. Rugged strength. For rough work or fine grading. A money maker for its owner.

Buckeye

SURFACE MATERIAL SPREADER FOR ACCURACY

Lays down exactly measured volume of material over every square yard of surface to be covered. Saves time, labor and material. Handles sand to 1 inch stone and spreads volume from a mere sprinkle to 60 pounds per square yard. Helps make those spreading jobs profitable.

PAVEMENT WIDENING MACHINE FOR SPEED

Digs trench of uniform width and depth, leaving subgrades undisturbed, true to grade, clean and ready to receive material. Digs at rate of mile or more per day.

BID THE **Buckeye** WAY

ask for our operation data before you bid

The BUCKEYE TRACTION DITCHER *Company* FINDLAY, OHIO

THE BUCKEYE TRACTION DITCHER CO., FINDLAY, OHIO

☐ SURFACE MATERIAL SPREADER
☐ PAVEMENT WIDENING MACHINE
☐ SEND A SALES ENGINEER

CLIPPER EXCAVATOR
☐ MODEL 50—½ YD.
☐ MODEL 60—⅝ YD.
☐ MODEL 70—¼ YD.

☐ SHOVEL
☐ TRENCH HOE
☐ CRANE
☐ CLAM SHELL
☐ DRAGLINE

DATE 1938

YOUR NAME

COMPANY NAME

CITY OR POST OFFICE STATE

LAUGHLIN Industrial Hardware

Specializing for over 70 years in the design and manufacture of wire rope and chain fittings, LAUGHLIN has established a record of dependability through the use of the best metals and other materials, expert workmanship, modern machinery, and rigid inspection.

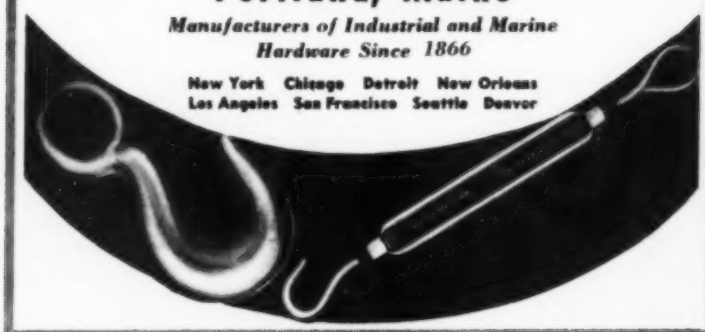
Send for catalog showing the complete line of LAUGHLIN Industrial Hardware.

THE THOMAS LAUGHLIN CO.

Portland, Maine

Manufacturers of Industrial and Marine Hardware Since 1866

New York Chicago Detroit New Orleans
Los Angeles San Francisco Seattle Denver

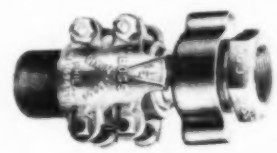


BETTER PERFORMANCE LONGER SERVICE ON ANY JOB

"DIXON" AIR HAMMER COUPLINGS

Designed and built to withstand the continual vibration of hand hammers and rock drills, this Dixon coupling has a longer, consistently economical service life on the toughest job. And, like the "Boss," it is rust-proofed by Cadmium Plating.

"BOSS" HOSE COUPLINGS



Used for steam hose, steam hammers, air, hydraulic or road builders' hose . . . "Boss" Couplings have no equal for dependability in service. Parts are of steel or malleable iron to withstand abuse . . . Cadmium Plated for rust proofing.

Furnished in Washer or Ground Joint Type.

DIXON VALVE & COUPLING CO.

LOS ANGELES PHILADELPHIA HOUSTON

Carried in Stock by Leading Rubber Manufacturers and Jobbers.

"WHY SHOULD WE PAY THE LONG PRICE FOR A HEAVY-DUTY JOB?"
HERE'S A 1½-TON CHASSIS
THORNTON-eered TO HANDLE 20 TONS!
(GROSS VEHICLE WEIGHT)
THORNTON
DRIVE

THORNTON STANDARD UNIT recommended for loads up to 26,000 pounds, gross vehicle weight (as a truck).

THORNTON "BIG BOGIE" UNIT recommended for loads up to 30,000 pounds, gross vehicle weight (as a truck).

EVERY DAY, in dozens of industries, shrewd operators are finding the answer to their truck problems in the dependable, year-'round, heavy-duty performance and economy of lighter trucks with Thornton Four-Rear-Wheel Drive engineered into the original chassis.

Thornton engineering permits extra carrying capacity, of course—but of greater importance, it provides *double the power to pull it* where there isn't a road—and *plenty of speed* on the highway.

Thornton Four-Rear-Wheel Drive is considerably more than a third axle, more than a dual-ratio transmission, more than a piece of equipment attached to a truck chassis. It is a thoroughly engineered installation which affords the operator distinct performance advantages over large, heavy-duty, single-driving-axle trucks of equal rated capacity—with substantial savings in initial cost and expense of operation and maintenance.

Before buying that big, expensive truck, see proof of the extraordinary results delivered at low cost by the 1½-to-3-ton truck—Thornton-eered.

THORNTON TANDEM COMPANY
5151 Braden Street **DETROIT, MICHIGAN**
Distributors in every large industrial center
SEE THE THORNTON DISPLAY AT THE ROAD SHOW—SPACE B-19

CHOOSE YOUR 1½- to 3-TON CHASSIS..have it

THORNTON-eered

C.M.C. AGAIN OUT IN *Front!*

SPACE E-23 MAIN EXHIBITION HALL, CLEVELAND, JAN. 17-21st

YOU'LL SEE AND HEAR ABOUT THEM AT THE ROAD SHOW

CMC New Streamlined, fast moving, 2-wheel Trailers in 5s, 7s and 10s sizes.

CMC Compact, 4-Wheel Side Discharge Models in 5s, 7s, 10s sizes. Also built as End Discharger.

CMC New Dual Prime Pumps 1¼ in. to 6 in. A proved design — improved to bring unbelievable speed in priming and pumping efficiency

CMC General Utility Double Drum Hoist. 100% hoisting efficiency without extravagance.

CMC Dumpover Pneumatic Tired Carts. Faster material handling at lower cost.

Here are a few of the highlights in the 1938 CMC line of equipment. The big new CMC Catalog pictures and describes the finest and most complete line of equipment offered in our nearly 30 years experience. Get this catalog. See the wonderful improvements in CMC Mixers all types and sizes. Plaster Mixers, Dual Prime Pumps, Hoists, Pneumatic Tired Carts, Wheelbarrows and Saw Rigs.

CONSTRUCTION MACHINERY CO.
WATERLOO, IOWA

98% *of your questions* answered *in these two books*

By G. UNDERWOOD
Construction Engineer

Estimating Construction Costs

630 pages, 6 x 9, 443 charts, 36 illustrations, flexible, $6.00

THIS book provides a simple chart system that gives construction costs at a glance and takes long and tedious headwork out of estimating. Over 400 of the charts are given in ready form for handy use, and cover the estimating of transportation, labor and material costs for all kinds of construction work. The book also presents a complete model estimate for a typical small building, together with a step-by-step description of the methods followed in making it.

CONTENTS: 1. Transportation of Materials. 2. Handling Materials. 3. Excavation. 4. Piling. 5. Concrete. 6. Wood Construction. 7. Brick, Tile and Stone. 8. Structural Steel. 9. Lathing and Plastering. 10. Roofing, Flashing and Waterproofing. 11. Pipework and Heating. 12. Plumbing. 13. Electrical. 14. Painting and Glazing. 15. Machinery and Machinery Erection. 16. Overhead. 17. Estimating. 18. Prices of Material.

Standard Construction Methods

SECOND EDITION
490 pages, 6 x 9, 422 illustrations, flexible Keratol, $5.00

HERE is a manual of actual construction methods — methods that are used every day by practical engineers, superintendents and others upon whom rests the responsibility of getting things done. It covers construction methods thoroughly — from first steps in organization and equipment to pipe work and painting — from excavation and pile driving to roofing and plastering.

CONTENTS: 1. Organization and Equipment. 2. Excavation. 3. Pile Driving. 4. Concrete Construction. 5. Wood Construction. 6. Brick and Stone Construction. 7. Steel Construction. 8. Roofing and Flashing. 9. Lathing and Plastering. 10. Scaffolds and Material Towers. 11. Erection and Rigging. 12. Pipework. 13. Painting. 14. Construction Schedules.

Examine either or both of these books for ten days free. Just send the coupon. Pay for or return the books after you see exactly what value they hold for you.

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Send me the books checked below for 10 days' examination on approval. In 10 days I will pay for the books, plus a few cents postage and delivery, or return them postpaid. (We pay postage on orders accompanied by remittance.)

☐ Underwood — Estimating Construction Costs, $6.00.
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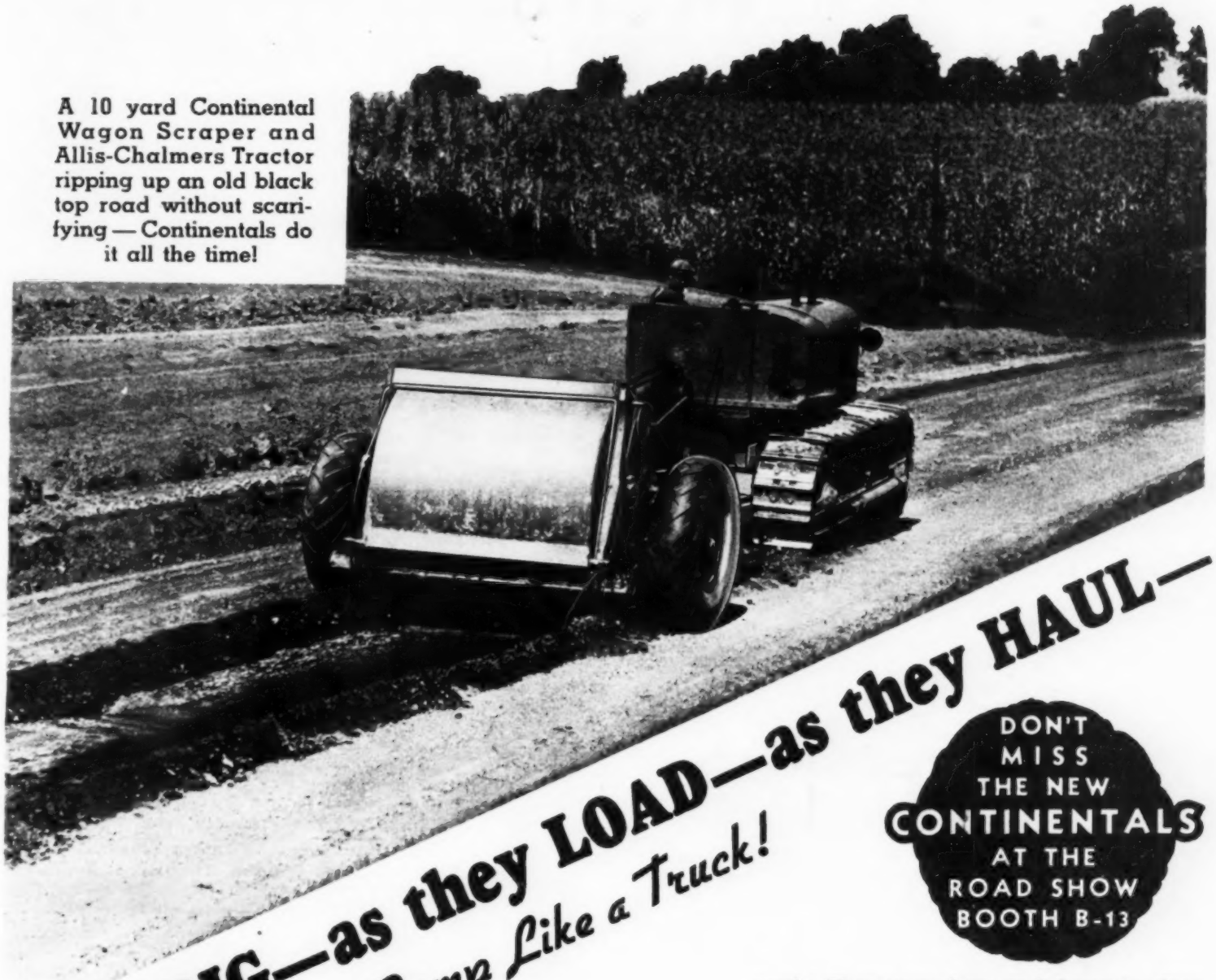
(Books sent on approval in U. S. and Canada only.) C.M. 1-38



A 10 yard Continental Wagon Scraper and Allis-Chalmers Tractor ripping up an old black top road without scarifying — Continentals do it all the time!

They DIG—as they LOAD—as they HAUL—

and Back Dump Like a Truck!

DON'T MISS THE NEW CONTINENTALS AT THE ROAD SHOW BOOTH B-13

A turn of the hydraulic control lever and the Continental's sharp-edged cutting blade digs in — the full weight of the entire unit is behind it — it hogs out everything it goes after! It loads as it digs, the dirt smoothly sliding up and into the front carrying apron and body — no resistance, no obstruction — full loads on every trip!

While it is digging and loading it's also hauling — it's on its way to the dump! Only Continentals back dump like a truck — operating as smoothly backward as forward — backfilling is easy — they windrow dump — stock pile — level and grade. They turn short and dump in close quarters. They dig anything the tractor can pull through — rocks, imbedded roots, gumbo. They're light, fast, rugged, easy on the tractor, easy on the operator, and easy on the maintenance man! If your present equipment can't match this performance, then it isn't worth a Continental!

Continental offers a complete line — 4, 5, 7 and 10 yard sizes with balloon-tired wheels; and 5, 7 and 10 yard sizes mounted on crawlers.

Continentals perform the greatest number of dirt moving operations at the lowest cost per yard. For 1938 — don't overlook Continentals — look them over!

Sold by Allis-Chalmers dealers everywhere.

Continental Features:

1. Lightest in weight, yet strongest!
2. Simplest in design and all working actions!
3. Require less tractor power!
4. Backfill entirely over a bank!
5. Dump in close quarters!
6. Turn short and back easily!
7. Load, dump and haul faster!
8. Used for spreading and grading, too!

CONTINENTAL ROLL & STEEL FOUNDRY COMPANY
Tractor Equipment Division
14370 Railroad Avenue • East Chicago, Indiana

CONTINENTAL WAGON SCRAPERS

RECOMMENDED BY LEADING CONTRACTORS EVERYWHERE

The upper picture shows a 3" Sterling Pump sold by Wm. H. Ziegler Company, Inc., of Minneapolis, in use by Haagenson & Tranby of Crookston, Minnesota.

Sacra & Watts Contractors, Denver, purchased a 5" Sterling Pump from Hendrie & Bolthoff Manufacturing & Supply Company and use it under the severe conditions shown below.

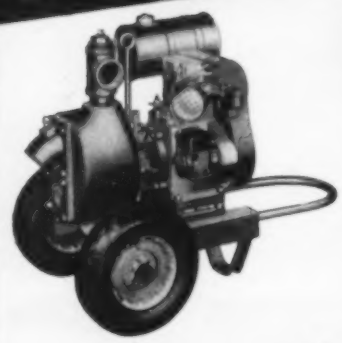
Ask Haagenson & Tranby or Sacra & Watts or any other Sterling user — then you'll know why leading contractors everywhere recommend Sterling.

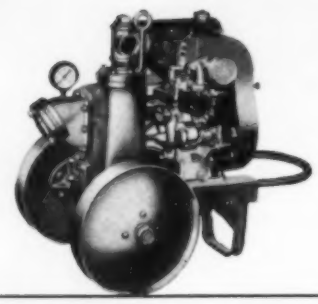
YEARS OF PROVEN DEPENDABILITY FAVOR STERLING

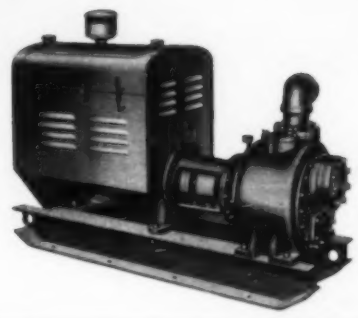
USE STERLING SERVICE THAT SAVES

Saves because Sterling can furnish exactly the right pump for the job — and Sterling pumps are Modern — Highly Efficient — Simple — Dependable — Rugged and above all — Thoroughly Tried and Proven.

The three pumps illustrated are the 7M — 10M and Model SJPB high pressure jetting pump — a few of the complete Sterling line of low and high head pumps in sizes ranging from 1¼" to 10".







Sterling
MACHINERY CORPORATION
Southwest Boulevard at Broadway KANSAS CITY, MISSOURI

SPRING WASHERS

Spring washers and lock washers of every type and size, including the well-known Hipower and Kantlink types. There are thousands of more places where spring washers would improve the value of any product where bolts, nuts, cap or machine screws are used.

STEEL BARREL CLOSURES

Forged and machined fittings for steel barrels, drums, tanks and metal packages, including plugs, rings and flanges. Very rugged for use in transportation of alcohol, turpentine, oils and other expensive liquids.

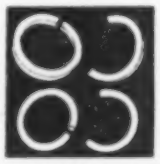
STEEL ROD ENDS

Drop forgings including steel rod ends of the adjustable yoke, plain yoke, and eye types. These articles in standard sizes and threads afford tremendous savings over special designs.

CONTAINER HANDLES

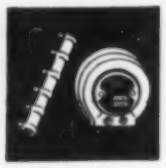
Forged steel handles for heavy containers—can be rigidly welded, riveted or attached by a strap to lie flat when not in use. Rugged and most satisfactory for hard usage.

RETAINING RINGS



Spring retaining rings of special heat-treated spring steel are carried in many stock sizes—both open and closed types. Use of a spring retaining ring is an excellent manner of creating a shoulder on a shaft.

RHEOSTATS–RESISTORS–LOAD BOXES AND SPECIAL APPARATUS



Our electrical division—Hardwick, Hindle, Inc.—makes as fine electrical resistance products, fixed and variable, as can be devised

Other products include windows for buses and railway cars, railway car window curtains, curtain rollers and fixtures, sash locks and lifts.

THE NATIONAL LOCK WASHER COMPANY
NEWARK, N.J. – EXPORT DIV., 15 E. 26 St., N.Y.C.

COMPLETE SERVICE

LACLEDE

ON HIGHWAY STEELS

CONTROLLED MANUFACTURE

QUALITY PRODUCTS

See the LACLEDE EXHIBIT at
THE ARBA CONVENTION CLEVELAND OHIO
JANUARY 17 - 21

LACLEDE STEEL COMPANY
SAINT LOUIS, MISSOURI

BAKER BULLDOZERS

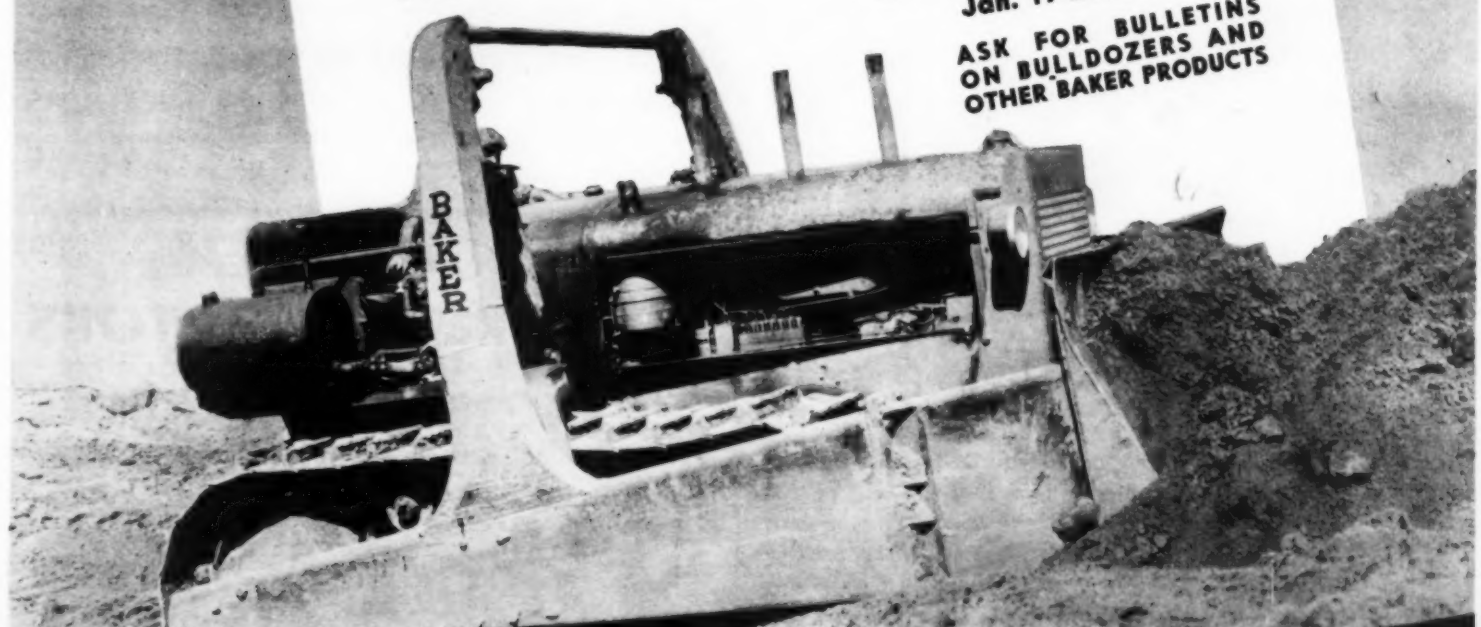
THE KIND WITH THE DIRECT LIFT

THE preference for Baker Hydraulic Bulldozers and Gradebuilders is easy to explain. Twin-cylinder, direct lift, a distinctive Baker feature, makes a direct saving. There are fewer parts to wear — no cranks, levers, wheels or springs — no loose joints. This means less delay on the job. There is tremendous down pressure of the blade where needed and rugged strength for the toughest jobs. You get easy, accurate control with one lever.

Simplicity is built into every detail of construction in mounting and in hydraulic operation. Interchangeable moldboards, another Baker feature, gives you all-year-round use for your power plant. No wonder they call Bakers "the simplest Bulldozers made"

VISIT OUR EXHIBIT AT **ROAD SHOW**
CLEVELAND
Jan. 17-21, 1938

ASK FOR BULLETINS ON BULLDOZERS AND OTHER BAKER PRODUCTS



BAKER TRACTOR EQUIPMENT
BULLDOZERS GRADEBUILDERS
HYDRAULIC SCRAPERS ROOTERS
ROAD DISCS MAINTAINERS SNOWPLOWS

THE BAKER MFG. CO.
568 STANFORD AVE.
SPRINGFIELD, ILL.

Your Best Insurance Against Shut-Down Losses!

GOODALL
"ROADBUILDERS" HOSE

The forced shut-down of a modern paver or mixer is a costly proposition. The importance of any step taken to *minimize* the risk of such loss cannot be argued. That's why contractors who watch their costs buy GOODALL "ROADBUILDERS" HOSE. They've learned that it can be depended upon to withstand, far better than hose of any ordinary construction, the severe surface wear, high pressures and generally *tough service* that hose in this work is subjected to.

Put "ROADBUILDERS" on *your* jobs, *now* . . . and reduce the risk of shut-downs to the remotest chance!

A GOODALL *"Standard of Quality"* PRODUCT
(Reg. U. S. Pat. Office)

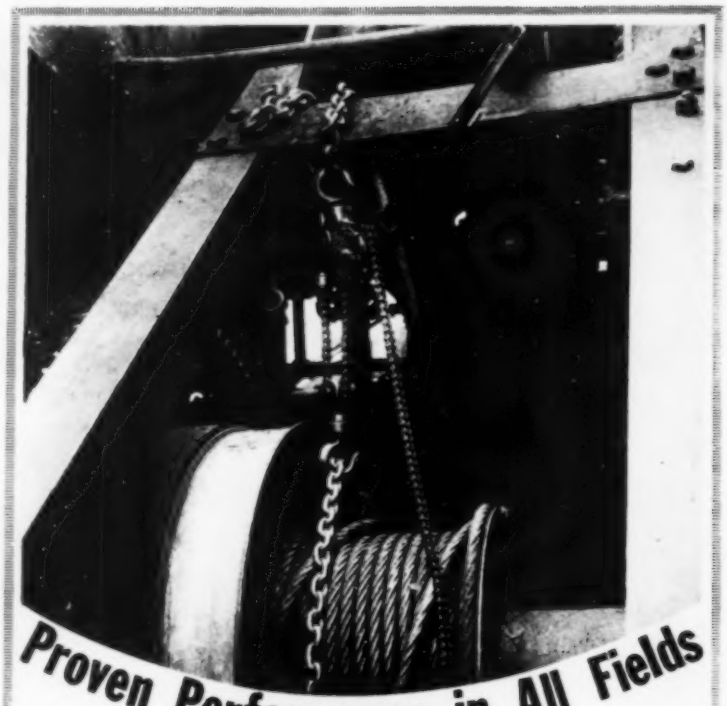
Available in Sizes 1" to 2" Inclusive — Maximum Lengths of 50'

GOODALL RUBBER CO.
5 S. 36th STREET, PHILADELPHIA, PA.
New York • Chicago • Pittsburgh • Cleveland • Houston

GOODALL MECHANICAL CORPORATION
San Francisco • Los Angeles • Seattle

FACTORY — TRENTON, N. J. *Distributors in Principal Cities*

GOODALL The originators of the "Standard of Quality" Line (Reg. U. S. Pat. Off.) of contractors rubber goods



Proven Performance in All Fields

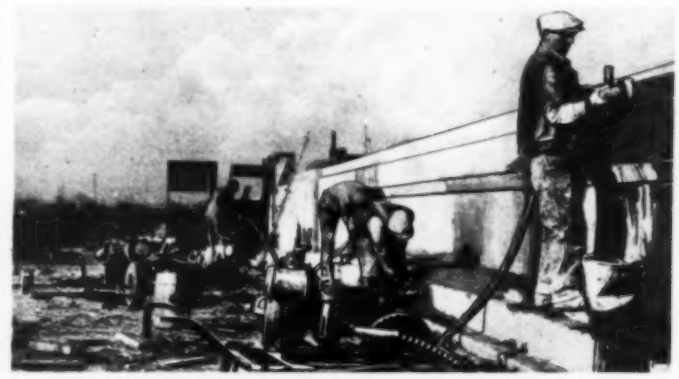
This picture tells another story of the remarkable time and labor saving value of the Coffing ratchet hoist on repairing shovels. Its light weight, power, compactness, and durability enable the user to save the small first cost of the Coffing hoist many times over. Built in capacities ranging from ¾ to 15 tons, weighing from 14 to 300 lbs. Write us for thirty days' free trial.

Ratchet Lever • Spur Gear • Electric Hoists • Load Binders

COFFING HOIST COMPANY
DANVILLE ILLINOIS

Mall TRADE MARK
CONCRETE VIBRATORS AND CONCRETE SURFACERS

The Same Power Unit Can Be Used for Both Operations!



A battery of MALL gas engine concrete surfacing machines.

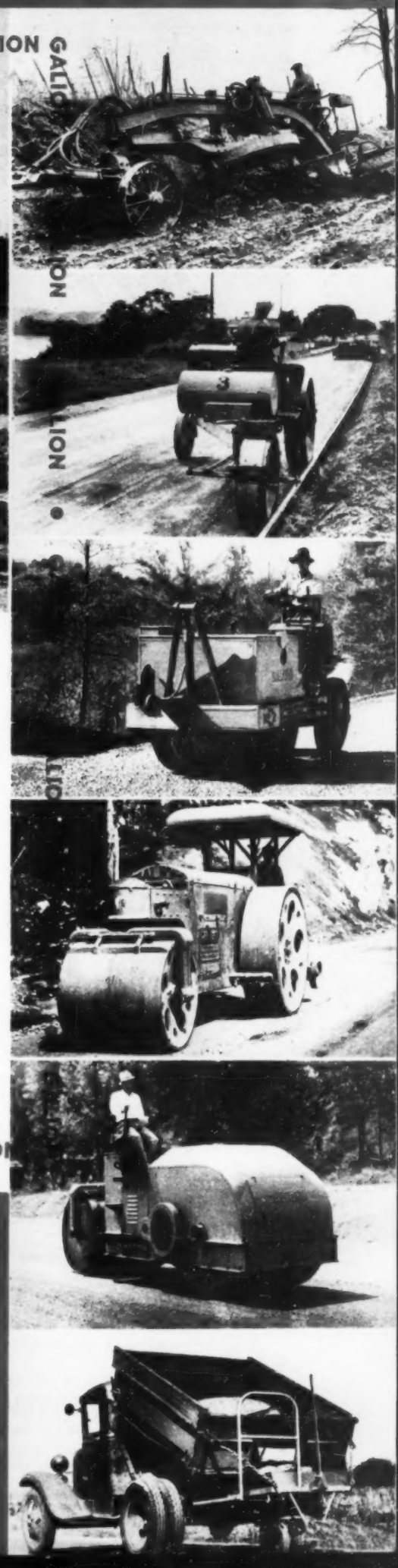
By using MALL concrete vibrating and surfacing machines, concrete of superior grade and appearance can be secured over hand puddled and hand rubbed concrete.

You will make greater profits on your next job by using these efficient labor-saving, quality-improving tools.

See these tools in operation at the Road Show Space E-40A

MALL TOOL COMPANY
7757 South Chicago Avenue, Chicago, Illinois
OFFICES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Inspect These Units AT THE ROAD SHOW



On with the show! And don't forget the headline attraction that will be put on by the seven-star Galion cast, fresh from many cost-cutting victories in the road building and maintenance field. Yes Sir! A parade of Galion motor graders, pull-type graders and rollers moves into Cleveland the week of January 17th with more new and improved features than ever before available on units of this type. The Galion cast is ready for the one-week stand at the Road Show. We hope you like it.

THE GALION IRON WORKS & MFG. CO.

Main Office & Works — **GALION OHIO**

Export Division — **COLUMBUS OHIO**

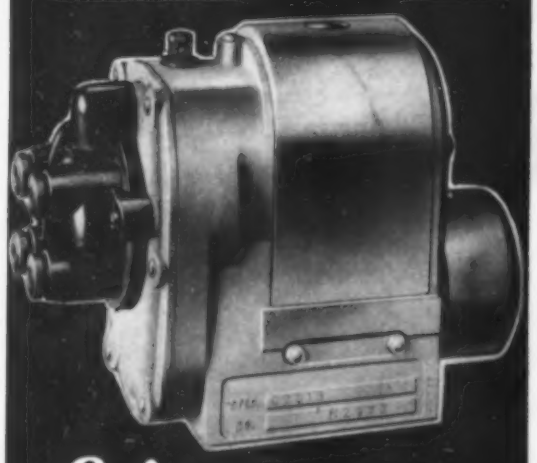
GALION ROAD MACHINERY points to better roads

GALION

Road Building and Maintenance

EQUIPMENT

Edison . . . the Accepted Standard of Quality



Edison "CD"

Solid Die Cast Rotor — Dust and Moisture Proof Housing —Sealed Ball Bearings— Fully Enclosed Impulse Starters—Fatigue Proof Breaker Bar Springs.

More than ever before, reliable magneto ignition is imperative for trouble-free operation, because of increasing compression ratios.

Construction equipment manufacturers are safeguarding the reputations of their products by equipping them with Edison CD Magnetos . . . the accepted standard of quality and performance under all conditions.

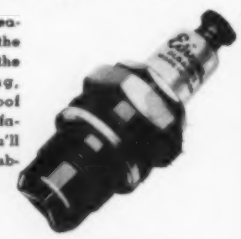
For the "lighter" construction equipment the swing is to the Edison RM Magneto, competitively priced and specifically engineered for trouble-free service.

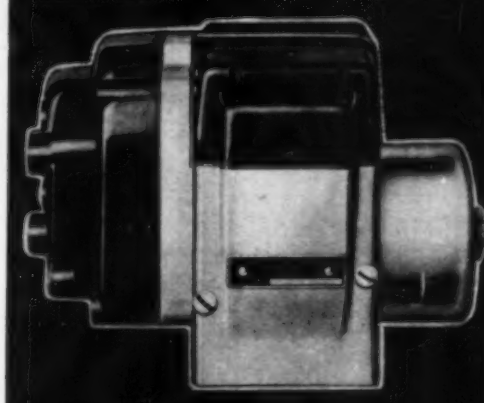
Specify CD or RM Magnetos for typical Edison performance and unequalled economy in operation.

Write today for illustrated literature completely describing their design and construction.

Try a set of
Edison SPARK PLUGS

Exclusive Edison Features incorporate the Albanite Core . . . the power-conserving, Built-In Leak-Proof Gasket and the famous Edispark. You'll be amazed at the substantial savings.





Edison "RM"

Rotary Magnet of Alnico—Dust and Moisture Proof Housing—Sealed Ball Bearings—Fully Enclosed Automatic Impulse Starter —Fatigue Proof Breaker Bar Spring.

EDISON-SPLITDORF CORPORATION — ONE OF THE Thomas A Edison INDUSTRIES — WEST ORANGE, NEW JERSEY

SPEED UP NUT TURNING WITH THE **FAVORITE** REVERSIBLE RATCHET **WRENCH**

The "FAVORITE" is a safety wrench — it does not leave the nut until it is seated or removed. Slipping, and damage to the nut as well as to the knuckles, is done away with. The ordinary open-end wrench has to be lifted from the nut at every quarter turn.

The "FAVORITE" is a time-saver, with its straight-ahead ratchet motion. By throwing pawl, reverse action is instantaneous.

The "FAVORITE" turns two different-sized nuts in each head — one on each end. A distinct saving in number of parts to hold in stock.

Opening clear through head for free passage of bolt.

SEND FOR DESCRIPTIVE FOLDER

GREENE, TWEED & CO.
SOLE MANUFACTURERS
109 DUANE STREET — NEW YORK, N. Y.

A New Portable **BITUMINOUS MIXING PLANT**

FOR MODERN ROADWORK

. . . at Low Cost

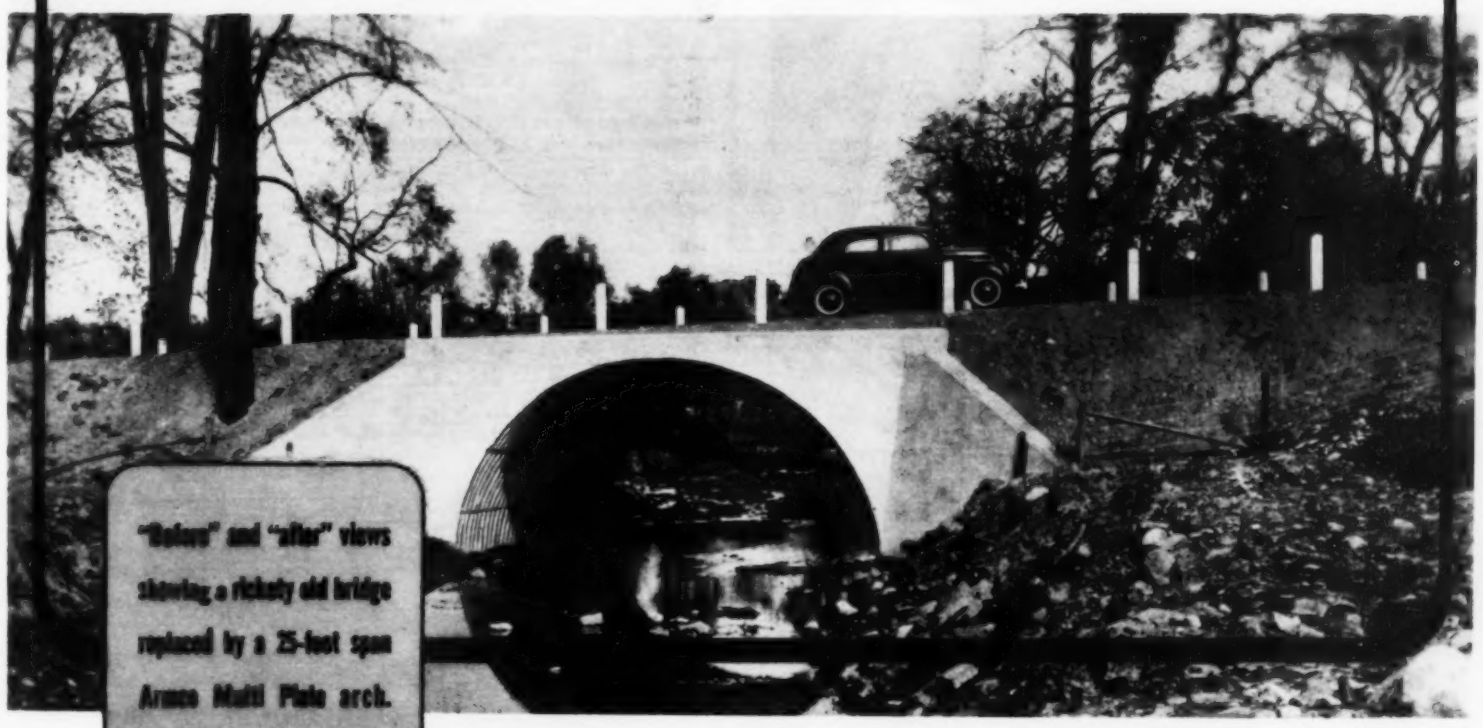
This plant was designed to meet the demand for the economical improvement of secondary roads. We have built several to date and they have proved their worth in actual service. No investment is needed for a running gear, plant adapted to standard flat bed truck and trailer hauling.

Some Details

- Can be erected by 3 or 4 men in a few days.
- No erection equipment required. Plant equipped with hoist and jib crane.
- Built in 2 units (dryer unit; and screening and mixing unit).
- Comply with most highway loading and clearance regulations.
- S.K.F. bearings throughout. Fully enclosed vibrating screen. Steam-jacketed, steam-operated steel mixer. Large combustion chamber and dust collector.
- Write for Bulletin T-250.

HETHERINGTON & BERNER, INC.
701-745 Kentucky Avenue — Indianapolis, Ind.

TURN YOUR "BAD BRIDGES" INTO GOOD ONES



"Before" and "after" views showing a rickety old bridge replaced by a 25-foot span Armco Multi Plate arch.

START NOW on a definite program to make all your small bridges *as safe and attractive* as your roads. You'll be surprised how quickly and economically these needed improvements can be made with Armco Multi- Plate. • Designing with these heavy corrugated iron plates, you can widen or replace an average small bridge *in a few days* without interrupting traffic. No special equipment is required for erection. And once the earth backfill is placed you have a sturdy, low-cost bridge that should last a lifetime without upkeep or repairs. • Call in an Armco representative real soon and let him show you how little it will cost to "turn *your* bad bridges into good ones." Armco Culvert Manufacturers Association, 703 Curtis Street, Middletown, Ohio.

MULTI ARMCO PLATE

ARMCO MULTI PLATE

A PRODUCT ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS

- THEY'RE STRONGER
- THEY'RE EASIER TO WORK WITH
- THEY'RE LESS EXPENSIVE TO BUY
- THEY'RE LESS EXPENSIVE TO USE

RICHMOND CONE SNAP TYS

are better buys for 4 out of 5 plumb wall jobs

We don't say that RICHMOND CONE SNAP TYS can be used in *all* plumb wall jobs, but we do say they can be used in 80% of them!

RICHMOND CONE SNAP TYS break ¼" inside the wall. They are far stronger than tying devices which break back 1" from the wall. Bend a RICHMOND CONE SNAP TY — and it breaks back of the ¼" deep washer. And — RICHMOND CONE SNAP TYS not only cost you less to buy, but they cost you less to use for the time, labor and materials they save.

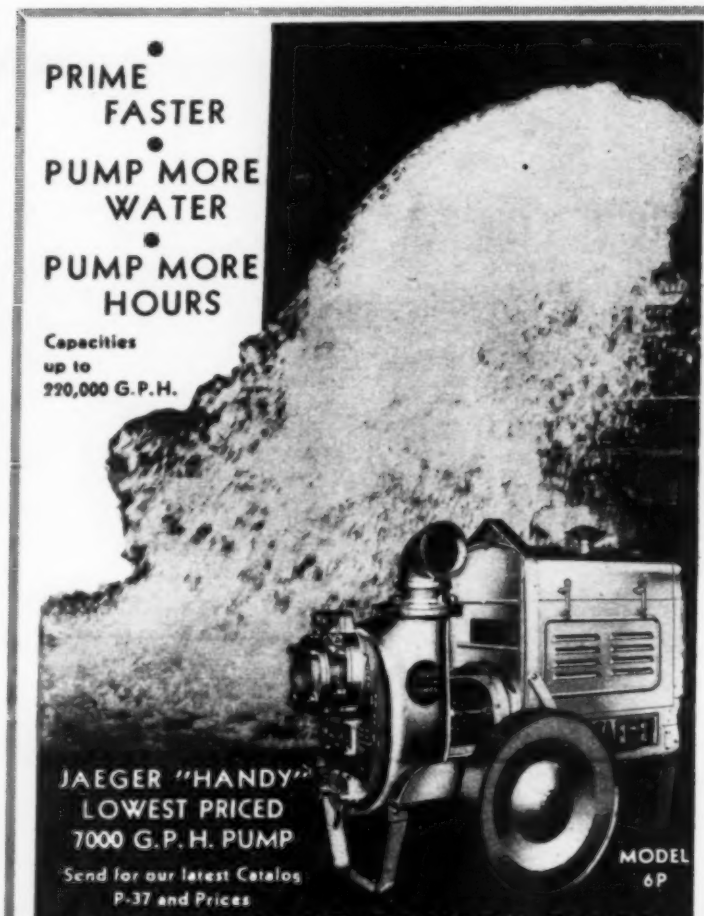
Before you invest in tying materials for your next concrete wall job, look into RICHMOND CONE SNAP TYS. A note to us, outlining your problem, will bring you the complete story and a sample.

We also make 1" break and extract types of snap tys. Samples on request.

RICHMOND SCREW ANCHOR CO., INC.
Tying Devices for Concrete
241-251 BUSH STREET BROOKLYN NEW YORK

PRIME FASTER
PUMP MORE WATER
PUMP MORE HOURS

Capacities up to 220,000 G.P.H.



JAEGER "HANDY" LOWEST PRICED 7000 G.P.H. PUMP

Send for our latest Catalog P-37 and Prices

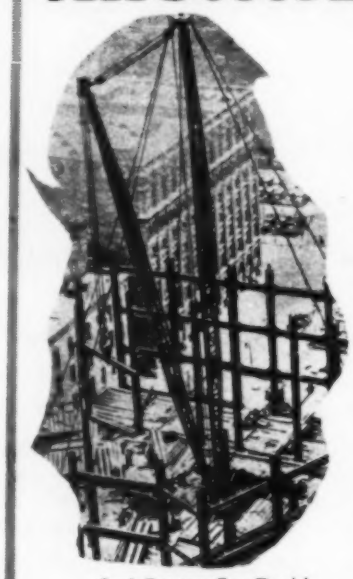
MODEL 6P

JAEGER "SURE PRIME" PUMPS

THE JAEGER MACHINE CO.
800 Dublin Avenue Columbus, Ohio

TRADE MARK DOBBIE ESTABLISHED 1862

All Steel DERRICKS



Steel Erectors Guy Derrick, with Ball Bearing Footblock.

Guarantee Safety

When you guarantee safety, you economize — for safety means uninterrupted operation and lowest possible maintenance costs.

And DOBBIE All-Steel Derricks have been designed for safety and consequent economy. They have a safe load capacity of almost twice their rating. You need this assurance of dependable safety and continuous performance.

SAVE POWER BY USING BALL OR ROLLER BEARING FOOTBLOCKS AND SHEAVES. Built in both Guy and Stiff-leg types. Write for information and prices.

DOBBIE FOUNDRY & MACHINE CO.

Niagara Falls, N. Y.

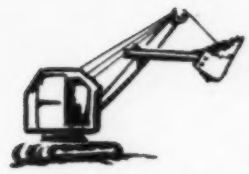
Other Dobbie Products—Steel Derricks, Timber Derrick Fittings, Hand Winches, Motor Driven Winches, Blocks, Sheaves, etc.

INSLEY

PROFIT MAKER

MOBILE
POWERFUL
SPEEDY
STURDY

NATIONALLY SERVICED



Powered for emergencies . . . . Insley excavators travel fast and operate fast. They make profits!

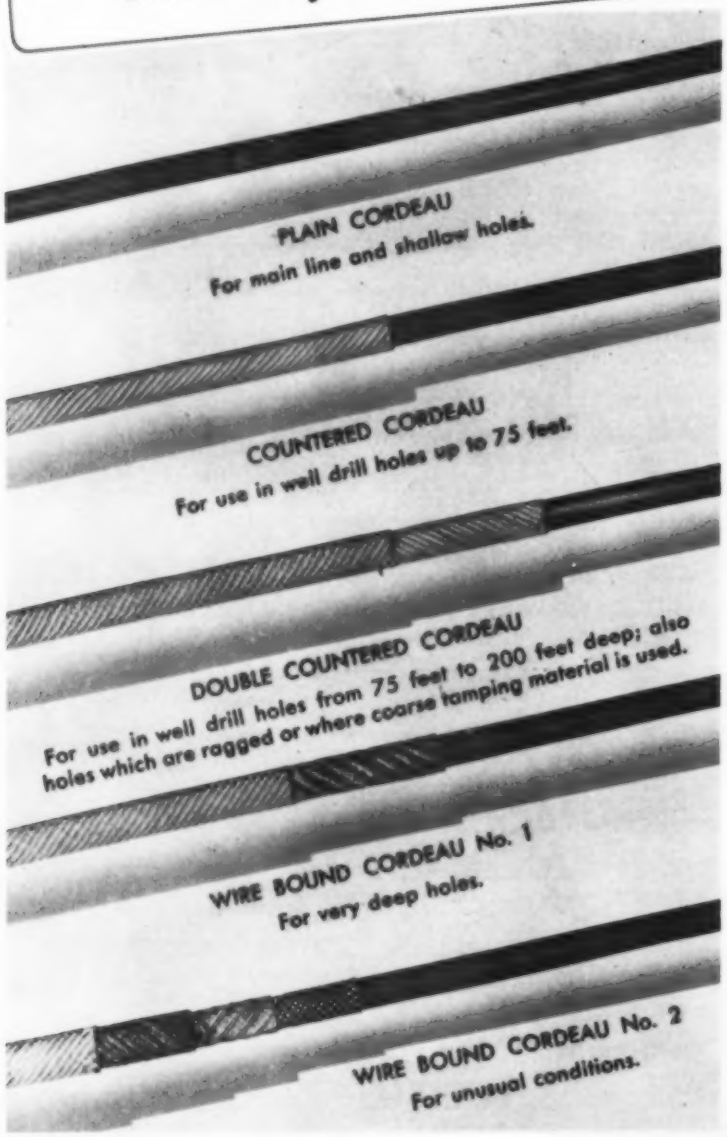
Abundant power, lighter and stronger electric welded construction, and independently controlled crawlers, makes Insley equipment outstandingly mobile and easily maneuvered in any situation.

Shovel, dragline, trench hoe, and clamshell attachments are all readily interchangeable. This fast, powerful, sturdy, modern equipment built by the specialists who pioneered the 3/8 and 1/2 yd. excavators is well worth your careful consideration.

INSLEY MANUFACTURING CORPORATION
801 OLNEY STREET · INDIANAPOLIS, INDIANA

INSLEY

Use the *right* CORDEAU for the job . . . . .

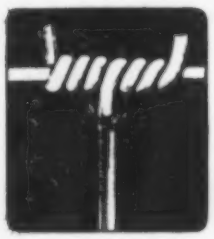

PLAIN CORDEAU
For main line and shallow holes.
COUNTERED CORDEAU
For use in well drill holes up to 75 feet.
DOUBLE COUNTERED CORDEAU
For use in well drill holes from 75 feet to 200 feet deep; also holes which are ragged or where coarse tamping material is used.
WIRE BOUND CORDEAU No. 1
For very deep holes.
WIRE BOUND CORDEAU No. 2
For unusual conditions.

Easy as choosing a collar button . . . yet the *right* type of Cordeau is *double* insurance of success in many blasting operations.

Cordeau-Bickford is an insensitive detonating fuse. It acts as the detonating agent for all cartridges in each hole, and it connects all holes. A single cap and fuse or electric blasting cap, applied to the proper main line of Cordeau above ground, detonates the entire blast.

At the right are shown five standard types of Cordeau-Bickford Detonating Fuse. Send for a copy of the Cordeau Book.

CORDEAU·BICKFORD



Detonating Fuse

CB68

THE ENSIGN-BICKFORD COMPANY
SIMSBURY, CONN

LITTLE THINGS LIKE A SELF-CLEANING LOWER SHEAVE BLOCK MAKE A BIG DIFFERENCE

No pocket under these sheaves

The next time you need a digging bucket BE SURE TO ASK FOR HAISS BULLETIN 25" before you go any further. You owe it to your crane and operator to hang a HI-POWER on the line. Simple rugged strength PLUS supreme digging efficiency.

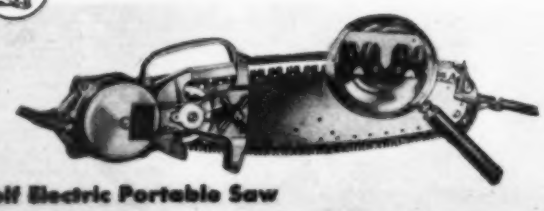
GEORGE HAISS MFG. CO., INC.
139th St. & Canal Pl., New York
Represented in all Principal Cities

ASK FOR BULLETIN 134 ON THE BIG "135" HAISS LOADER

● The Texas and New Orleans Railroad Company are big users of timber — operating their own wood preserving plant — where the accompanying photograph was taken. Besides endorsing the dependable, efficient, service rendered by their Wolf Portable Sawing Machine they estimate a definite saving of $16.00 a day in time and labor costs.

Wherever large quantities of heavy timber piling, etc. must be cut, the Wolf Portable Sawing Machine can be relied upon to pay for itself in a short time — and to earn a big profit for many years afterward. Made in 16", 24", 36" and 48" capacities. Driven by either electric, air or gasoline motors. Write today for complete information.

REED-PRENTICE CORPORATION
WORCESTER MASS.



Wolf Electric Portable Saw

THE EARTH MOVES ...ON GOODYEARS

SHOWN AT WORK, above, are Goodyear Sure-Grip Tires. Below, Goodyear All-Weathers.

IN THE COMPLETE Goodyear line of truck tires, there is a type and size for every earth-moving or road-making requirement —for tractor semi-trailers, dump trucks, scrapers, motor patrol graders, etc.—a tire *to fit your work* as precisely as it fits your rims.

That's one reason why—wherever earth is moved, wherever trucks roll—more tons are hauled on Goodyear Truck Tires than on any other kind.

THE GOODYEAR TIRE & RUBBER COMPANY, INC.
AKRON, OHIO

GOODYEAR

YOU CAN FEEL THE TIRES TAKE HOLD ON THIS "TRACTIONIZED" TARVIA PAVEMENT!

Barrett Tarvia

GOOD ROADS AT LOW COST

See Tarvia Exhibit National Road Show, Cleveland, Ohio, January 16-21. Booth D-34.

THE BARRETT COMPANY New York Chicago Birmingham St. Louis Detroit Buffalo Providence Lebanon Rochester Baltimore Minneapolis Cleveland Columbus Philadelphia Toledo Youngstown Syracuse Hartford Boston Milwaukee Cincinnati Bethlehem Portland, Me. Norwood, N. Y. In Canada: **THE BARRETT COMPANY, LTD.** Montreal Toronto Winnipeg Vancouver

America's Leading Manufacturer of Coal-Tar Products

ROOFINGS • WATERPROOFING • TARVIA • CHEMICALS

AGAIN - FOR 1938

SEE THE NEW WHITES AT THE ROAD SHOW!

White Heavy Duty Model 722

NOW, MORE THAN EVER BEFORE, WHITE HAS THE MOST COMPLETE LINE FOR EVERY EARTH MOVING AND CONSTRUCTION JOB

FOR 1938 White offers the most complete line and range of capacities in its history. Light Duty! Medium Duty! Heavy Duty! C. O. E. types for maneuvering in restricted space! Six-wheelers for the big jobs! Special chassis for dump trucks—concrete mixers—pressure distributors—snow removal—and any other special requirement!

Few, and far between, are the contractors, road builders, earth movers, who don't know White Trucks through use or by reputation.

On the comparatively small jobs—and all the way to the largest million dollar projects—this last year has again proved that no trucks can match Whites for power—adaptability—dependability—low cost performance—and downright *earning power.*

Do more work and make more money—with Whites! Before you start your 1938 program, see what White has in every capacity and price range.

You are cordially invited to visit the White Factory while you are in Cleveland. For transportation to and from the Factory just call at the White Exhibit Space in Public Auditorium or telephone the Factory, HEnderson 2000 and ask for Mr. Ptak.

AT CLEVELAND PUBLIC AUDITORIUM:
Be certain to visit the White Exhibit. Space C-26.

*

Watch for special Whites on display in other manufacturer's exhibits.

White TRUCKS

THE WHITE MOTOR COMPANY • CLEVELAND

Answers to your problems in structural engineering always at your finger tips

EVERY man concerned with the design and construction of civil engineering structures of any type should have these practical books with their helpful tables, diagrams, reference data, best methods and details.

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Structural Engineers' Handbook Library

6 Volumes—3575 pages—fully illustrated

The most valuable library obtainable for any man concerned with the design and construction of civil engineering structures of any type.

Under the general editorship of George A. Hool, formerly Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, Professor of Structural Engineering, University of Wisconsin, Editors-in-Chief of the Library, *Sixty-Six* of the leading, practical operating structural engineers of the United States and Canada give you the very cream of their knowledge of structural engineering.

They give you six well bound, fully illustrated volumes, containing 3,575 pages of practical, authoritative information covering every phase of structural engineering from foundation and substructure work to the completed erection.

Every man concerned with the design and construction of civil engineering structures of any type should have these practical books with their helpful tables, diagrams, reference data, best methods information and details. The six books are:—1. Foundations, Abutments and Footings. 2. Structural Members and Connections. 3. Stresses in Framed Structures. 4. Steel and Timber Structures. 5. Movable and Long-Span Steel Bridges, and, 6. Reinforced Concrete and Masonry Structures. With these books on hand you cannot make mistakes.

By placing this Library on your bookshelf you are putting within arm's reach years of actual first rate experience with structural problems. Do not forget either, that these men are all EXPERTS in their lines.

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Home Address .....

City and State .....

Name of Company .....

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(To insure prompt shipment write plainly and fill in all lines.) C.M. 1-38

Rogers Trailers for 1938 . . embodying well proven, fundamental features of Rogers design . . . engineered from tip to tail . . . completely electric welded . . . electric steel castings throughout . . . mounted on pneumatic tires . . . equipped with an original system of equalizing brakes.

These features combine to give a stronger but lighter trailer that hauls more easily at lower cost . . . that is under absolute control at all times regardless of road or load conditions.

There are types and sizes of Rogers Trailers for all needs reflecting essential knowledge gained by years of specialization. Look up these latest developments of the pioneer trailer builders at the Cleveland road show . . . see the new braking system in action . . . or write for the latest Rogers catalog.

ROGERS BROTHERS CORPORATION
Albion, Penna.

Builders of LOW BED *and* GIRDER TYPE HEAVY DUTY TRAILERS *Exclusively*

The **WORLD'S MOST PORTABLE HOIST**

For all construction jobs, SULLIVAN PORTABLE HOISTS are preferred equipment for all progressive construction companies.

BECAUSE their light weight per horse power developed allows speedy low-cost transportation from one job to another. This cuts down the number of hoists necessary to complete each job and gives the lowest possible overall operating costs.

Photo above shows one of forty gasoline driven 8 h.p. G-112 hoists owned by the Chicago Bridge and Iron Company, erecting tanks for a large oil company. Many other sizes available.

SULLIVAN MACHINERY CO.
CLAREMONT, NEW HAMPSHIRE

RELIANCE for Road Job Profits..

There is a complete line of Reliance Road Equipment of every variety — and just two of its outstanding items are shown here. Their points speak for themselves.

RELIANCE CRUSHING PLANTS

A properly set up RELIANCE Crushing and Screening Plant will give you maximum capacity and least vibration. RELIANCE Steel and Wood Bins are rapidly, replacing other types, as they are supplied completely fabricated, easy to erect. RELIANCE Crushing, Elevating, Washing and Screening Units need no "selling" to experienced contractors. They can be put together to work out a plant of any capacity desired, at least expense for erection and operation. RELIANCE plants are also made in Portable types.

Send for new CATALOGS Nos. 10 *and* 28

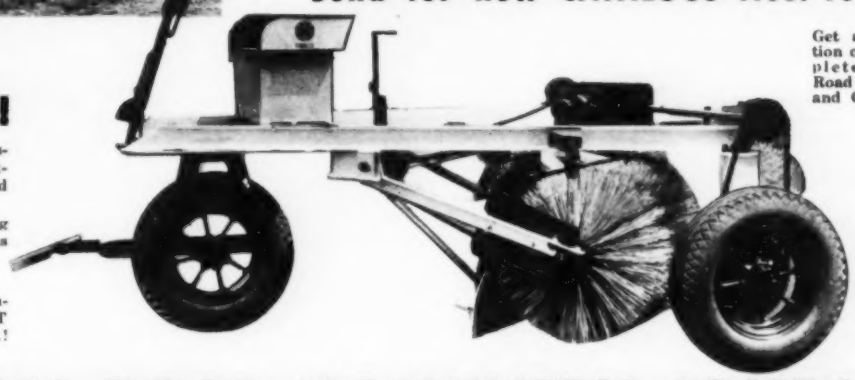
3 WHEEL SWEEPER—NEW!

Three wheel chassis provides 3 points suspension, giving short turning radius, making unit extremely easy to handle and steer.

New method for raising and lowering broom. Broom mounted diagonally across frame.

Frame all steel construction.

The Reliance is backed by 30 years manufacturing experience. It is the BEST BUY in today's street sweeper market!



Get all the desired information on every item in the complete RELIANCE line of Road Building, Maintenance and Quarry Equipment.

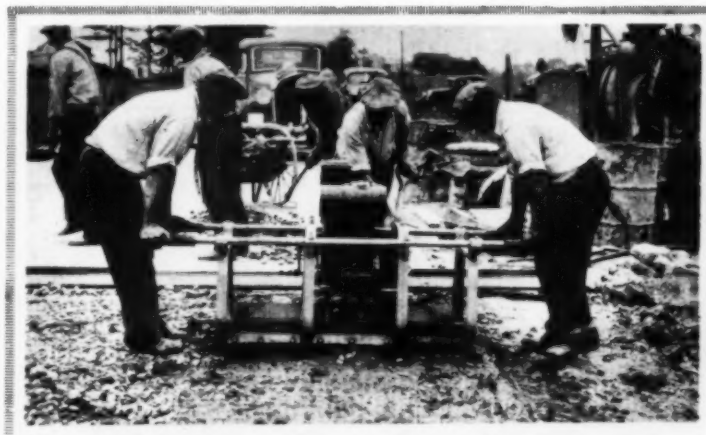
PRODUCTS

Reliance offers a complete line of Rock Crushers; Bucket Elevators; Revolving Screens; Scarifiers; Storage Bins; Pulverizers; Car Unloaders; Chip Spreaders; Heating Kettles; Bin Gates; Feeders; Belt Conveyors; Grizzlies; Air Separators; Sand and Gravel Spreaders; Wash Boxes.

UNIVERSAL ROAD MACHINERY COMPANY

NEW YORK OFFICE 114 LIBERTY ST. — **KINGSTON, N. Y., U. S. A.**

DISTRIBUTORS IN ALL PRINCIPAL CITIES OF U. S. A.



VIBRATED

ROAD PATCH REPAIR

(all concrete)

AT LAST . . . An ideal, all concrete, road patch that can be opened to traffic three hours after completion. This is made possible by a patented method of applying high frequency vibrations—The International Way—to old broken concrete bonded together with very stiff mixes of sand and cement grout.—No more red lights or barricaded sections of road during the patching season—

- BETTER
- CHEAPER and
- FASTER PATCHES

for repairing concrete roads. This proven method is also applicable to road widening with the least possible interference to traffic. Full details of costs, strength and charge for rental of complete equipment, on a trial basis, sent upon request.

THE INTERNATIONAL VIBRATION COMPANY

16702 WATERLOO ROAD

CLEVELAND — OHIO

DRY SUBGRADES AT A FIXED COST

This and two other huge river jobs are being dewatered under a Moretrench contract. We have the experience, the equipment and the personnel to dry up any size job on a contract basis.

MORETRENCH CORPORATION

Sales and Rental Office:
90 West Street, New York

Works:
Rockaway, New Jersey

Goodbye Water . . . They Installed a GRIFFIN WELLPOINT SYSTEM

A FEW MAJOR JOBS DE-WATERED IN 1937

POWER HOUSE CONTRACTS:

- Owen-Ames-Kimball Co., Grand Rapids, Michigan
- Jerome A. Utley, Detroit, Michigan
- Thomas O'Connor Co., Boston, Mass.

BRIDGE CONTRACTS:

Middletown to Portland, Conn.
Merritt-Chapman-Scott Corp., New York, N. Y.
Port Huron, Mich. to Sarnia, Canada
The Missouri Valley Bridge & Iron Co.
Leavenworth, Kansas.
Allegheny River — Pittsburgh, Pa.
- Holmes Construction Co., Wooster, Ohio.

BUILDING CONTRACTS:

Ford Motor Company
Frankini Const. Co. — Medford, Mass.
Sheffield Farms Milk Depot
George J. Atwell Foundation Corp., N. Y. C.

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- Tully & Di Napoli, Inc., Long Island City, N. Y.
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Oliver J. Trudeau, Detroit, Mich.

*Now working in the DRY.
Other contracts completed.

Part Of The Dewatered Foundation For The Burroughs Adding Machine Company New Plant
Albert Kahn, Inc., Archts. & Engrs., Detroit, Mich.

Catalogs — Estimates — Layouts — on request — NO OBLIGATION

GRIFFIN WELLPOINT CORPORATION

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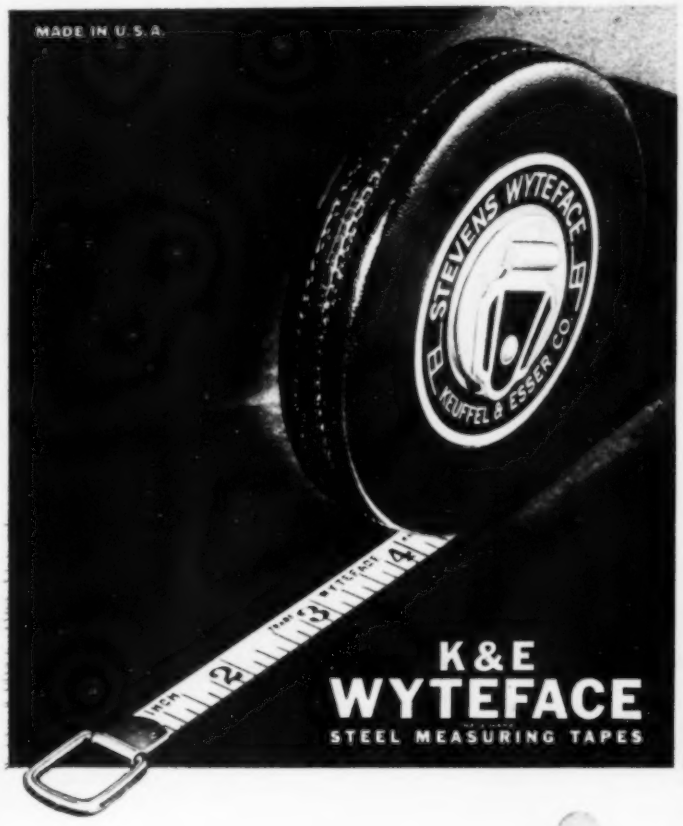

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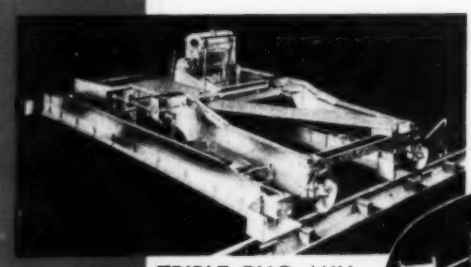

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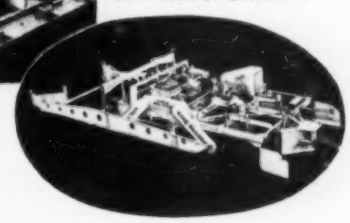

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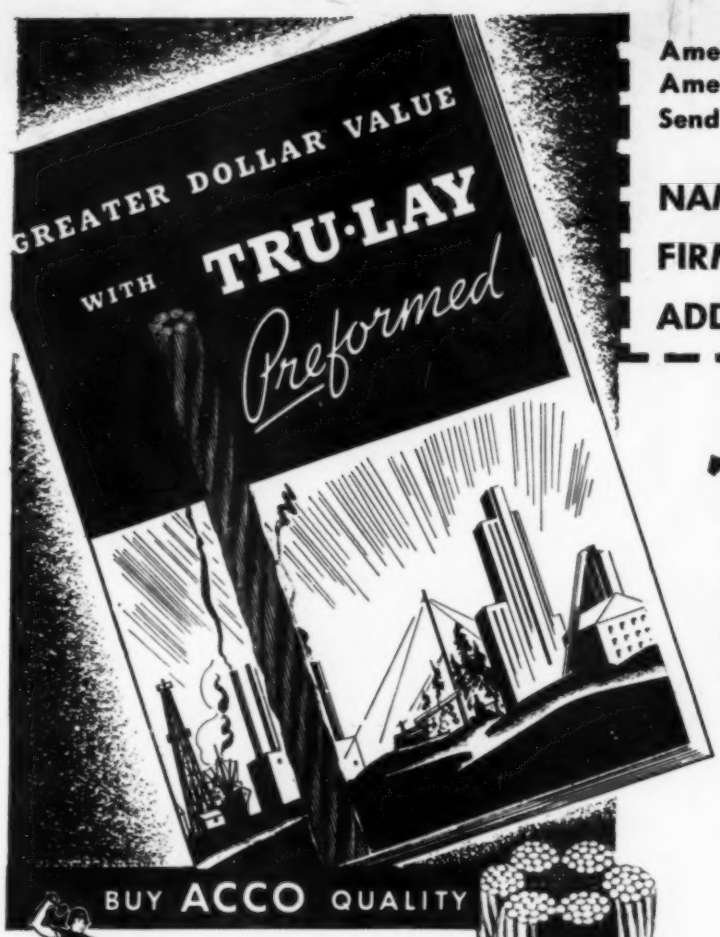

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